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INFLAMMATION OF THE SINUS MAXILLARIS WITH SPECIAL REFERENCE TO EMPYEMA: THE SURGICAL PATHOLOGY, DIAGNOSIS AND TREATMENT.

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The importance of this subject cannot be denied in the light of our present day knowledge, clinical evidence having sufficiently accumulated to clearly demonstrate the important rôle which accessory sinus inflammations may play in the causation of disease. Such cases are frequently of interest, not only to the oculist, the rhinologist and the dentist, but also to the general practitioner and surgeon. Thus obscure cases of general systemic infection, of rheumatism, of leukemia, or of asthma, etc., may frequently be accounted for.

In order to determine what percentage of the accessory sinuses of the nose presented pathological conditions, the writer undertook a series of investigations during March and April of 1909. This was made possible through the courtesy of Prof. Hofrat Weichselbaum, Prof. Ghon and Prof. Stoerk. One hundred miscellaneous heads were examined, a few hours after death, in the autopsy room of the Allgemeines Krankenhaus in Vienna. Of this series 43 presented some evidence of inflammation of varying intensity. Of these cases 37 were examples of antral disease; which made an astonishingly high percentage. It is the object of this paper, therefore, to put on record the results of this series of examina-

tions with special reference to the microscopical details of the surgical pathology, and to demonstrate thereby: *First*, how easy it is to overlook collections of pus in the antra; and *Second*, how frequently a fatal result may follow neglect of this condition.

The maxillary antrum is the most usual site of inflammation when the accessory sinuses are involved because, in addition to its exposure on the nasal side to all inflammations which affect the nares, it is liable to infection from carious teeth; and it may act as a reservoir for any excess of secretions from either the frontal sinus or the anterior ethmoidal cells, both of these last-named air spaces having an opening in common with the antrum into the infundibulum. The results of my investigations certainly prove this conclusively.

Before considering my series of cases in detail, let me refer briefly to the surgical anatomy of the parts under consideration. These observations are based upon a special anatomical study of the accessory sinuses during the last two years. For this purpose I have examined several hundred dry skulls, many of which I was able to section, and also over 500 wet preparations.

ANATOMY OF THE SINUS MAXILLARIS.—GENERAL CONSIDERATIONS. For purposes of description the antrum may be regarded as a pyramid, the apex of which presents outward and lies underneath the most prominent part of the malar bone. The base of the pyramid is represented by the nasal wall and is the only portion which is normally made up partly of bone and partly of membrane. The external wall, the posterior wall, the roof and the floor form the four sides of the pyramid and will be described, in detail, later.

The antra are the only accessory sinuses which are present at birth; at which time they are slit-like cavities and can, as a rule, be easily demonstrated. They practically reach their full development about the age of 20, when the upper jaw is in full possession of all the permanent teeth. At maturity they are, as a rule, unquestionably the largest of the accessory sinuses.

In order to demonstrate the actual size of the antra in an adult head, I made the Wood's metal cast² as shown in Figure 1. This cast shows the relation of the two antra to the ethmoidal cells, the nares, and to each other. The drawing represented in Figure 1 is taken from above downward, with the preparation directed obliquely toward the observer. There was no injection of the frontal sinus secured in this way to be of any consequence. It has, therefore, been disregarded.

In Figure 1, the ethmoidal sinuses, both halves of the anterior nares with a space between them, representing the position of the cartilage of the nasal septum, and the roof of the mouth are shown. Figure 2 represents the appearance of both antral casts isolated and seen from in front. In this drawing, as well as in the next one, the relative positions of the ostia are well shown. Figure 3 shows the lateral view of this pair of casts, while Figure 4 gives the posterior-inferior view.

It will be seen from these drawings that an irregular pyramid practically describes the shape of the normal, adult, maxillary antrum. The base is concave in both specimens and the casts are wedge-shaped both anteriorly and posteriorly.

The right maxillary cast displaced $13\frac{1}{2}$ cc. and the left, 14 cc. of water, approximately; while Brühl²³ states that the average capacity of each adult antrum is about 10.5 cc.

The actual measurements also of these casts are somewhat larger than those given by H. Lambert Lack,¹² (see Figure 5) but they are small compared with half a dozen that I secured in my autopsy series. The largest maxillary antra that I met in this series measured 4 by 4 by $6\frac{1}{2}$ cm. The capacity of such an antrum would be considerably greater than the capacity of those shown in the cast. The more specimens I examined, the more I was convinced of the great variety in size and shape of these air spaces.

In order to demonstrate the ordinary appearance of the normal antrum I made a series of frontal sections through several frozen heads. The section shown in Figure 6 is from a formaline head, the saw-cut passing through the first molar tooth. After being sawed, the section was polished while still frozen; the resulting surface, as shown in the photograph, by this procedure being clear-cut.²⁴

Figure 7 shows the anterior view of the second slice from this same head. In that photograph a bristle will be noted passing from the left frontal sinus through the infundibulum into the antrum. No force was required in the passage of this bristle. Such communications between these two sinuses are not unusual and help to corroborate the statement made by Zuckerkandl that all cases of frontal sinus and ethmoidal sinus inflammation are accompanied by antral inflammation. This is borne out in my series by cases 3 and 22.

Figure 9, which is a photograph of a bone preparation, also illustrates this communication between the frontal sinus and the

antrum. Clinical experience shows that in all cases of chronic inflammation of either of the above associated sinuses the antrum, sooner or later, is always involved. This is explained by the fact that the antrum often acts as a reservoir, as already noted.

Figure 8 represents the posterior view of the same formaline section as shown in Figure 7. It demonstrates the outline of the antra in this position, the thickness of the alveolar floor about its middle and the direction of the bristle passing through the natural ostium from the frontal sinus.

Figure 10 is a photograph of the last section of this same head to show the posterior walls of the antra and the relatively greater thickness of the floor in this position. Figures 11 and 12 give two similar views of another head in very much the same situation. These latter sections are only about half an inch or 13 mm. thick. The relative position of the antral floor to the floor of the nose is shown in all of these frontal sections.

The relation of the floor of the antra to the floor of the nose, that is to say, whether one is above a vertical line in relation to the other, or below such a line, will depend upon the point at which such a transverse or frontal section is made. The thickness of the alveolar wall or floor in the same specimen will also vary with the point at which the section is made. If this section is made through the middle of the floor, it is invariably thinner than if made slightly in front or behind the middle. Therefore, the normal line of the floor of the nose on cross-section passes through the bottom of the antra in most cases. In some antra their floor is above this line, depending in a measure upon where the cross-section is made, while in very large antra their floor is below such a line.

The floor of the maxillary sinus varies in thickness, not only in the same specimen, from before backwards, but also presents very different relations with the teeth in their sockets in every case. The varying thickness of the alveolar floor is shown in the drawings represented in Figures 13, 14 and 15. Two teeth, namely, the second bicuspid and the first molar, are usually in closest relation to the antral floor. If the antrum is very much increased in size over the normal, more of the teeth may come into intimate relation with the floor in addition to the two above mentioned. Thus, one writer¹⁴ claims that any or all of the teeth may project their prongs into this floor.

ALVEOLAR FLOOR. Figure 13 is a drawing of a very thin alveolar floor taken from the left antrum of case 99 of my autopsy series.

Nothing intervenes between the prongs of the tooth and the cavity of the antrum but an extremely thin layer of bone covered by mucous membrane. The thinness of this layer might be compared to two sheets of ordinary writing paper. This close relation between the prongs of the first molar tooth and the mucous membrane covering the floor of the antrum would naturally predispose the patient to inflammation of the antrum if caries of this tooth should occur. As a matter of fact, however, despite the common occurrence of such anatomical conditions, those⁵ best informed on this subject, claim that dental caries produces only 10 per cent of the cases of empyema, the remaining 90 per cent being due to intra-nasal conditions. Practically, however, in cases where the alveolar floor is as thin as that represented in Figure 13, there is a greater predisposition to dental caries than in cases where the alveolar floor is as thick as that shown in Figure 14. Between these two extremes there are, of course, all manner of examples of an intermediate thickness. The sections shown in Figures 6 to 10 may be considered, therefore, of this intermediate type.

Figure 15 is an example of an unerupted tooth causing irritation and inflammation in the floor of the right maxillary antrum. This drawing is made from a photograph of one of Dr. Cryer's preparations. This writer tells me that in his practice he has seen over 50 cases in which unerupted or impacted teeth of the upper jaw have been the cause of inflammatory conditions of the bone and mucous membrane surrounding the maxillary sinus. Dr. Cryer has also given me the history of the following case which has not before been published.

"A business man, about 50 years old, came to me September 18, 1908. On examination I found an opening into the maxillary sinus over the region of the right upper first molar, this tooth having been extracted. The second molar tooth was badly diseased and the floor of the sinus was necrosed. An operation was performed for the removal of this second molar tooth and the necrosed bone. The operation revealed several pockets of pus in the sinus and considerable thickening and inflammation of the mucous membrane. On October 24, I removed the third molar tooth in order to reach one of these pockets in the posterior part of the sinus, but the condition of the patient did not improve.

About a year later, or October 20, 1909, by probing I found the point of an impacted tooth in the upper anterior portion of the sinus, and as the canine tooth on the right side was not in position, I came to the conclusion that the 'germ' of this tooth was keeping up the inflammation, although the patient's dentist claimed that he had extracted it. An X-ray photograph confirmed the clinical diagnosis. On October 21, 1909, this canine germ

tooth was removed from the antrum, since which time the pain has been relieved, and the soft parts are healing nicely."

Destot¹¹ describes the case of a woman who for years had had a dental empyema, caused by an unerupted molar tooth which was not recognized until an X-ray photograph made the diagnosis unmistakable.

Taking, therefore, these three figures, 13, 14 and 15, as representing types of antral floors or alveolar processes, it may be stated as a general rule that the thicker the alveolar process, the less the danger of dental empyema.

As an additional evidence of the extreme thickness that the alveolar floor may attain, I would refer to Figure 43, which shows the actual size of an alveolar cyst imbedded in an antral floor without communication either with the antrum or the oral cavity.

NASAL WALL. The natural ostium of the maxillary antrum is usually found high up and about in the middle of the nasal wall. The position of this orifice is well shown in the antral casts (Figures 2 and 3). On the right side the Wood's metal of this cast formed a three-bulbed projection from the ostium into the infundibulum. On the left side it is shown as an oval stump measuring 5 mm. in its greatest diameter. These natural ostia are also shown in Figures 17, 18 and 20. In addition to these natural ostia, in about 20 per cent of the cases, accessory ostia exist, such as are shown in Figures 16 and 17.

The condition shown by the photograph in Figure 16 is an unusual one from the fact that the anterior of these two accessory openings passes through the uncinate process and, posteriorly, blends with the natural ostium.

It is quite usual to find more than one opening, as has already been pointed out. One of my cases, Case 12, had an accessory opening as large as a 10-cent piece, and although she had this opening, yet the case was an example of empyema. Ordinarily the possession of these accessory openings is a fortunate circumstance for the patient, their presence greatly lessening the probability of chronic inflammatory conditions of the antrum.

When the accessory openings are present the probing or washing out of the antrum is rendered very much easier than it would be under ordinary circumstances.

If we examine the nasal side of the nasal wall of the antrum as shown in Figure 19, we will see the three turbinate bones in position and their relations to each other. To observe the infundibulum

and relative position of the natural ostium, it is necessary to remove the middle turbinate, as shown in Figure 20. In this latter photograph the infundibulum is seen bounded in front by the uncinate process and behind by the bulla ethmoidalis. The infundibulum may be regarded as a funnel-shaped space into which the anterior ethmoidal sinuses and the frontal sinus open in common with the antrum. If we regard the infundibulum as a room in the bottom of which lies the opening of the maxillary sinus, the "hiatus semilunaris" may be regarded as a door to this room. The position of the natural opening in this specimen is shown by a probe introduced into the orifice (Figure 20). This natural ostium is always in one place practically, while the position of the accessory openings varies.

The direction of the hiatus semilunaris is mid-way between the middle border and the anterior end of the middle turbinate. This anterior end is often called the operculum. Sometimes it is necessary to remove part of the bulla ethmoidalis before entrance can be effected through the natural ostium into the sinus maxillaris. It is not, however, desirable or expedient to remove the uncinate process as it may open up ethmoidal sinuses. For the introduction of a probe into the maxillary antrum the flexible end should be bent downwards at right angles one cm.

It will at once be seen how many anatomical difficulties there are in the way of probing this sinus: 1. Either a very narrow, or a tortuous hiatus semilunaris, may interfere. 2. A large bulla ethmoidalis or some other overgrown air-cell from the ethmoidal labyrinth may interfere. 3. The middle turbinate may be cystic or swollen to such considerable thickness as to interfere very materially with the passage of a probe (see Case 28). 4. The presence of a polypus or other new growth may offer mechanical obstruction. In such cases it may require a fortnight, with the visits of the patient occurring at short intervals, to enter the antrum properly.

The nasal wall of the maxillary antrum is divided into two parts by the insertion of the inferior turbinate bone. Of these the lower portion is bony, while the upper portion is part bone and part membrane. This latter portion is therefore frequently spoken of as the nasal fontanelle.

In order to pass a probe into the maxillary sinus through the natural opening it is usually necessary to remove the anterior end of the middle turbinate, or the operculum, unless there should be

an accessory ostium present. These accessory ostia are usually found opening into the middle meatus much lower down than the natural ones, and vary in size from 1 to 9 mm. in diameter. The natural obstacles present when it becomes necessary to introduce a probe into the maxillary sinus, apply with even greater force to the washing out of that cavity. This process will be considered later under the head of treatment.

In a dried specimen or bony preparation the tissues closing in the natural ostium of the maxillary antrum are the palate bone, the ethmoid and the inferior turbinate. It is through the maxillary process of the inferior turbinate that puncture of the antrum should be made.

ANTRAL ROOF. The roof of the antrum varies considerably in thickness, but is ordinarily composed of a thin layer of bone in addition to the inner lining of mucous membrane. In Figure 18, a photograph of an oblique section through the antrum is shown in order to demonstrate how very thin this roof may be. Moreover, it is frequently partly absorbed in places so that in such cases it becomes part bone and part membrane, and resembles in this way the nasal wall. I have seen a number of skulls which show large natural openings in the bony roof, but I believe they are more common in elderly people. When such a condition of part membrane and part bone is present this antral covering might be called an orbital fontanelle. As is well shown in this photograph of an oblique section there is but little tissue intervening between the contents of the orbit and the antrum.

The external and posterior walls of the antra present but little of anatomical interest. The photographs already referred to give several interesting examples of these walls. Frequently the posterior wall, which lies close to the zygomatic fossa, is extremely thin, or even partly membranous.

FUNCTION OF THE ACCESSORY SINUSES. While the accessory sinuses serve a useful purpose in lightening the skull, their actual function has not been definitely determined. In regard to the maxillary antrum, it would seem that these air-chambers serve more for moistening the air on its way to the lungs than for any other purpose. In a normal condition these air spaces have a considerable quantity of moisture always present. The antra are well supplied with mucous glands, especially around the orifices of the ostia. The presence of these glands may be readily demonstrated by subjecting this mucous membrane to a dilute

nitric acid solution. In a very few minutes these glands become discolored by the acid and their appearance is readily demonstrated with the aid of a weak magnifying glass. These mucous glands are either absent or but sparsely present along the outer wall of the antrum.

In Figure 21 a photograph of a transverse section through a full-grown sheep's nose may be seen. This section was taken at about 10 cm. from the anterior nasal spine. In this specimen both maxillary antra are present. On one side the projection upward of an enormous tooth has almost divided this cavity into two parts, while on the other side this division is complete. The double scroll-like turbinates are also of interest as this type is sometimes approached in human turbinates.

In Figure 22 a photograph of a gnu's nose is shown taken in a relatively similar position. This animal belongs to the deer family, and his nasal apparatus is adapted to protecting him from the hunter. Several things may be noted from this section. In the first place, there are no maxillary antra present, although the penetration of the photograph is considerable on account of the oblique direction of the specimen and the scroll-like turbinates are well shown. This specimen I secured from a dealer in animal heads in order to show the character of the nose in an animal that has to run for its life. This latter photograph suggests the thought that the accessory sinuses may be retrogressive organs which, in the case of the maxillary antra at least, are not needed in animals requiring very acute and extensive olfactory organs; in other words, that the place occupied by the antra in man, is either largely or entirely occupied in the lower animals by more complicated turbinate bones.

GENERAL CONSIDERATIONS. Thirty-seven cases were selected from my autopsy series of 100 heads because in all of these cases the maxillary antra were the sinuses principally affected. Their histories follow.

While it is a difficult matter in every case to make sharp lines of demarcation between examples of edema, empyema or retention cyst, such a division was necessary in order to properly classify the cases. A sharp line of demarcation is difficult to draw because one condition frequently blends with another. Thus, in Case 30, while it was apparently a well-marked example of chronic inflammation of the antrum, upon microscopic examination a large retention cyst was also found, (Figure 29).

Case 82, of my autopsy series was an example of acute congestion of the mucous membrane of the left antrum. This man died of carcinoma of the bronchus at the age of 43. He was an attendant in a prison; autopsy, May 9. Microscopically the sections demonstrated very clearly only early inflammatory changes such as congestion and edema. There was no inflammatory exudate in this case, and it has not been included in the following series.

EXAMPLES OF EDEMA.

Case 1. A woman, 51 years old; a lay nurse; died of tubercular pericarditis. Autopsy, April 4. There was well-marked edema of the right antrum, the mucous membrane of which was very much thickened. Took a photograph of this condition (Figure 23), but did not secure a piece of this mucous membrane for microscopic examination. An interesting fact in regard to this case is that four weeks before her death she had an aphthous stomatitis, from which a rhinitis developed and subsequently this one-sided edema.

Case 2. A woman, 28 years old; a housewife; died of puerperal sepsis. Autopsy, April 14. Both antra were very large. There was a well-marked edema of the mucous membrane in the posterior part of the antrum of the right side. On the right side the first molar prongs projected into the antral floor. There was also a chronic inflammatory deposit in a recess in the floor of the left antrum. A nasty ozena-like deposit of mucus was found in the middle meatus of the nose. She had pronounced jaundice.

Case 3. A woman, 27 years old; a housewife; died of multiple sclerosis of the brain and spinal cord, also nephritis. Autopsy, April 16. There was edema of the right antrum. A cyst in the left antrum burst on being touched. An example of "edema bull-osa." There was a muco-purulent secretion in the right sinus frontalis. This was undoubtedly the cause of her antral edema.

Case 4. A woman, 26 years old; a housewife; died of eclampsia. Autopsy, April 21. There was edema of the left antrum but no pus.

Case 5. A woman, 46 years old; a pauper; died of endocarditis and pneumonia. Autopsy, April 26. There was edema of both antra. Took mucous membrane of right antrum, and a fragment of the nasal wall for examination. She had been in the hospital three or four times previously. Entered for the last time March 1, 1909, and died April 25.

Microscopically only a moderate amount of edema of both antra. Some chronic inflammatory thickening of the whole tissue. There

is also a scant infiltration with poly-nuclear and some mono-nuclear leucocytes. There are no important changes of the blood vessels. There is inflammation with edema and loose infiltration of the sub-mucosa. There is fresh hemorrhage below the epithelium and post-mortem loss of epithelium. Plasma stain shows red plasma cells in all parts of the inflammatory infiltration.

Case 6. A man, 27 years old; a coachman. Autopsy, May 1. Clinical diagnosis was lympho-sarcoma cutis, diffuse peritonitis and lymphatic leukemia. The diagnosis of leukemia was confirmed by Professor Weichselbaum. There was edema of the left antrum. I removed the entire mucous membrane from this cavity. *Microscopically* the epithelium is intact throughout the section which shows a great number of goblet cells. The cilia are preserved. The sub-epithelial connective tissue is edematous with widely distended intercellular spaces, the tissue of the net-work carrying numerous capillaries and small vessels. There is a moderate hemorrhagic exudation into the dilated spaces. There are a few scattered mono-nuclear leucocytes which not infrequently contain red blood corpuscles (or phagocytes). The deep layers of the mucous membrane are less edematous and sharply contrasting with the looser edematous superficial portion. There is a slight peri-vascular and peri-glandular lymphocytic infiltration. There is also slight irregular thickening of the blood-vessel walls from fibrosis. Many of the blood-vessels, however, are unchanged. See Figure 24 for a microscopic drawing of this specimen.

Case 7. A man, 22 years old; a tailor; had been ill for 4 weeks. The clinical diagnosis was acute lymphatic leukemia. There was sub-conjunctival hemorrhage, and hemorrhage from the mouth. Autopsy, May 4. Both maxillary antra were enormous. The right antrum showed edema, a recent hemorrhage and a large mucous cyst of a dirty brown color. This antrum measured antero-posteriorly 4 cm.; $2\frac{1}{2}$ cm. transverse diameter and 4 cm. from above downward. All the sinuses were large.

Case 8. A man, 70 years of age. Autopsy, May 9. Clinical diagnosis, senile marasmus and hypostatic pneumonia on the right side. There was edema of both antra. Removed posterior part of right antrum entire for examination.

Microscopically the epithelium is intact. The cilia are retained. There are occasional goblet cells. The epithelial tissues are thin and condensed immediately beneath the epithelium and in the deeper portions, showing slight edema. There is well-marked pig-

mentation of hemic origin. The blood-vessels are few, their walls sclerosed, and in some cases the lumen nearly obliterated. The tissues of this membrane contain but few cellular elements, presenting the appearance of an old, well-formed fibrous tissue. The mucous glands are few in number. This condition is probably the result of chronic atrophic nasal catarrh. There is rich pigment in the sub-epithelial connective tissue. The edema does not show well, but the specimen shows the early stage of metamorphosis from dilated duct to cyst.

Case 9. A woman, about 40 years old; a housewife. Autopsy, May 10. She had dilated cardiac ventricles, degenerative myocarditis, diffuse arterio-sclerosis of the thoracic aorta and embolism of the pulmonary artery.

There was edema of both antra. There was a small amount of edema bullosa of the right maxillary antrum. The frontal sinuses were small while there were large sphenoids and posterior ethmoids.

Case 10. A man, 50 years old; a railroad conductor. Autopsy, May 18. Clinical diagnosis, carcinoma recti. He had also an enormous cylinder-celled carcinoma of the liver. His sphenoidal sinuses were small. There was edema bullosa of the left maxillary antrum, superimposed on a mild form of edema.

Case 11. A man, 56 years old; a carpenter; died of syringomyelia affecting the medulla oblongata. All the sinuses were large. He had chronic cystic edema of the right maxillary antrum. No specimen of this tissue was preserved.

EXAMPLES OF EMPYEMA OR CHRONIC INFLAMMATION.

Case 12. A man, 63 years old; a tradesman. He entered the hospital for the second time on April 5. Autopsy, April 9. Cause of death, hepatic cirrhosis and lobular pneumonia. The antra were large. On the left side the antero-posterior diameter was $4\frac{3}{4}$ cm. by $2\frac{1}{2}$ cm. laterally. The right antrum measured $4\frac{1}{2}$ by $2\frac{3}{4}$ cm. and showed well-marked edema and empyema. The edematous mucous membrane from the posterior part of the right antrum was carefully removed for microscopic examination. No photograph was taken. There were large accessory antral openings. On the left side just above the lower turbinate this accessory opening measured 2 by $1\frac{1}{4}$ cm. or about the size of a 10-cent piece. Small natural openings were also present.

Microscopically the mucous membrane generally is more or less thickened and thrown into irregular folds. Over the surface of

the epithelium there are remnants of a purulent exudate. The epithelium is variable, but for the most part retained, showing occasionally cellular desquamation. A number of strata in the epithelial covering in some positions decidedly increased. There are occasionally goblet cells in layer and frequently leucocytic infiltration. In one portion of the membrane there is a multi-locular cyst several mm. in diameter containing a homogeneous colloidal-like substance. This filling substance is faintly tinted by eosin. The cyst is lined with a single layer of columnar epithelium without cilia and more or less flattened. The sub-epithelial wall of the cyst consists of the slightly condensed fibrous tissue of the mucous membrane. The mucous membrane apart from the cyst shows a slight generally edematous infiltration, the presence of poly-nuclear leucocytes, lymphocytes and plasma cells. There is a swelling of the endothelium of the capillaries and of the lymph spaces. There is moderate general hyperemia. No vascular fibrosis, and no mucous glands are seen in this section. There is a retention cyst which shows marked atrophy of the lining epithelium of the cyst due to internal pressure; loss of ciliary projections, with flattening of the cells and nuclei. (See microscopic drawing shown in Figure 29).

Case 13. A man, 74 years old; a butcher; died of endocarditis and arterio-sclerosis. Autopsy, April 13. He had also elephantiasis of the scrotum, cirrhosis of the liver and enlarged heart. His antra were very small and showed chronic empyema on both sides. Secured a piece of mucous membrane from the left antrum.

Microscopically there is a stroma of fairly dense fibrous tissue, a number of blood-vessels and a few more or less distorted glands. In this stroma there are numerous fibro-blasts, round and oval connective tissue-corpuscles. These are particularly accumulated in and around the blood-vessels. There is a sparse presence of plasma cells, and in places a number of phagocytes containing fine brown pigment granules. These latter are mono-nucleated cells. The blood-vessels frequently show a marked proliferation of the intima, occasionally almost completely closing the lumen. As a type they are provided with heavy and more or less fibrosed walls. (See Figures 25 and 26).

Case 14. A woman, 75 years old; a seamstress and pauper; died of pneumonia. Autopsy, April 19. She had entered the hospital only the day before. The largest frontal sinus was on the right side. She had a double antral empyema caused by a solitary

carious second molar on each side. In addition to her pneumonia and bronchitis she had chronic eczema. Specimens were preserved for examination. The left posterior ethmoidal sinuses were very large and were pushed back into the left sphenoid.

Microscopically the mucous membrane is generally of normal thickness, but there are some places where it is thickened mainly as the result of edema of the deeper structures. Adherent to the surface there are remnants of a purulent exudate. The epithelium is generally retained, but in places shows considerable desquamation of the superficial strata, and in some areas showing more or less reduction in the height of the columnar cells. When the membrane is entire the cilia are preserved, while in the deeper areas the cilia are missing. There are only occasional goblet cells. There is slight infiltration of the epithelial layer with leucocytes, and the superficial part of the sub-epithelial connective tissue contains a considerable number of young connective tissue-cells, leucocytes, lymphocytes and plasma cells. In some of these plasma cells 2 or 3 nuclei are not infrequent, making them practically resemble small giant cells. The deeper portions of the section are more edematous, loose in texture and contain fewer cellular elements. The capillaries show a moderate swelling of the endothelium. There is a fairly well-marked general hyperemia. The mucous glands are few in number and small. They are apparently normal. In short, there was a late stage of a chronic inflammatory process with edema in the deeper layers and infiltration of the sub-epithelial layers. In the latter tissues there was an increase of the small blood-vessels.

Case 15. A man, 63 years old; a post-office clerk. He entered the hospital February 28; died of bulbar paralysis, general arteriosclerosis and pneumonia. Autopsy, April 24. The sphenoidal sinus was a single cavity. The posterior ethmoidal cells were very large. There was pus and edema of the left antrum; or, in other words, empyema. There was no evidence of rhinitis.

Case 16. A man, 54 years old; a waiter. He died of otitis media and brain abscess for which he had been operated upon eight days previously. Autopsy, April 26. There was green pus in both maxillary antra, the left being especially full. There were carious molar tooth-prongs on both sides. It was, therefore, a case of dental empyema unrecognized during life. I took the mucous membrane from both antra for microscopic examination.

Microscopically the mucous membrane is irregular in thickness. The epithelium is preserved throughout the section. There are a

moderate number of goblet cells and slight infiltration with leucocytes into the epithelial layer. The sub-epithelial connective tissue is denser in the deeper portions, the seat of more or less edema and considerable leucocytic, lymphocytic and plasma-celled infiltration near the surface, with a minor grade of hemorrhagic infiltration into the same area. In one or two situations the tissues are necrosed and the large irregular interstitial spaces are filled with a hyaline coagulate of the edematous fluid. There is moderate injection of the blood-vessels. There are no important changes in the walls of the blood-vessels. The mucous glands are moderate in number. They vary from a normal appearance to that of beginning cystic dilatation. The lining layer of cells in the latter places is rich in goblet cells, and the dilated lumen contain a more or less homogeneous eosin-staining colloid-like material. This material might be conveniently called pseudo-mucin.

The appearance of the mucous membrane was similar to that of Case 14. In one place there was a very characteristic sudden dilatation of one of the mucous gland ducts, (Figure 27). This dilatation was bottle or flask-shaped. Such dilatation is the first stage of cyst formation.

Case 17. A woman, 42 years old; a housewife; died of myelitis and phthisis pulmonalis. Autopsy, April 26. There was dental empyema of the right antrum which was filled with green pus due to a carious second bicuspid. The other sinuses and nares were normal. This condition also was unrecognized during life. Removed the entire mucous membrane of the right antrum for examination.

Microscopically the mucous membrane is considerably thickened. Its surface is thrown into numerous papilliform outgrowths. The deeper tissues are richly edematous and highly cellular, especially toward the surface. There is marked widespread epithelial desquamation. The cellular infiltration of the superficial portion of the connective tissue is especially rich in the papilliform outgrowths which consist of a number of turgid capillaries surrounded by a loose reticulum in which there are great numbers of swollen and usually poorly staining lymphocytes and plasma cells with a small admixture of poly-nuclear leucocytes. The deeper layers of this mucous membrane become denser and in places almost hyaline. The blood-vessels in this latter portion are the seat of peri-vascular fibrosis. Numerous mucous glands are present, many of them showing slight dilatation with the same accumulation of colloid-

like material or pseudo-mucin previously noted. This was undoubtedly a case of chronic inflammation extending over a period of several months.

Case 18. A girl, 6 years old, entered the hospital April 1. Autopsy, April 29. She had been ill since March 30. She died of epidemic cerebro-spinal meningitis. An injection of serum, 20 cc. of Ruppel's,²¹ for this disease was administered on April 2, 6, 10 and 24. She had a "mild chronic otitis media on the left side." The frontal sinus was present only on the right side. She had acute empyema of both maxillary antra.

Professor Ghon made a culture of this pus. He found the diplococcus of pneumonia and the bacillus of catarrh but no micrococcus of meningitis.

During April and May of 1909, there was quite an epidemic of cerebro-spinal meningitis in Vienna and a number of examples of this disease came into the autopsy room. The above case is one of the most interesting of them all. This child had been under observation since March 30, or practically a year before she died. As already noted, both of her maxillary antra were filled with pus. This pus was of a yellow color and its presence had not been recognized during life. Whether these two foci of inflammation had any direct effect upon the cause of death it would be impossible to say. I did not have an opportunity to remove any of the mucous membrane from either of these antra, but judging from the microscopic examination of my other cases of empyema, this inflammatory condition probably existed for several months previous to the development of her meningitis.

Case 19. A man, 50 years old; a bartender. Autopsy, May 1. The clinical diagnosis was carcinoma of the intestines and post-hemorrhagic anemia.

The antra were very large. The left antrum was full of yellow pus not due to a carious tooth. Removed entire mucous membrane from this antrum which was very much thickened. The left antrum measured $3\frac{1}{2}$ cm. in its antero-posterior diameter; $2\frac{1}{2}$ cm. horizontally; 5 cm. from above downward. I also removed the mucous membrane of the right antrum. This man had a very thin skull and large frontal sinuses.

Microscopically the mucous membrane from the left maxillary antrum is thickened from edema and inflammatory cellular infiltration. The epithelial membrane is preserved but shows considerable superficial desquamation and marked infiltration of leucocytes. The

sub-epithelial tissue is generally edematous. This edema is most marked in the deeper portions with slight fibrinous deposit in the distended interstitial spaces. There is a hemorrhagic infiltration of moderate grade especially in the superficial position with scattered hemic pigment granules in the vicinity. The cellular infiltrate consists largely of poly-nuclear leucocytes with numerous lymphocytes and some plasma cells, mingled with which are numerous fragments of disintegrated cells. The endothelium of the capillaries and the lymph spaces is swollen and occasionally proliferated.

The mucous membrane from the right maxillary antrum of this case is rather thin with dense connective tissue rich in hemic pigment. The blood-vessel walls are thickened. The epithelium is universally lost. The mucous glands are absent. In other words, the left antrum showed inflammation with edema in the deeper layers, (Figure 28). There was an inflammatory infiltration in the superficial layers with streptococci in the exudate covering the epithelium. There were new-formed vessels, hematogenic pigment, and evidences of fresh hemorrhage. The mucous membrane of the right antrum showed a post-mortem loss of epithelium and an interesting richness of hematogenic pigment in the connective tissue.

Case 20. A woman, 74 years old; a pauper. Autopsy, May 2. She entered the hospital with a discharge from the nose. She was treated for meningitis. Autopsy showed atheroma of the thoracic aorta, atrophic arterio-sclerosis of the kidneys, catarrh of the intestines and marasmus. Her right middle turbinate had been removed 3 days previously. There was empyema of the right maxillary antrum from which I removed the entire mucous membrane in two pieces.

Microscopically the mucous membrane is irregularly thickened and the seat of an ulcer, the epithelial layer being retained, except over this ulcerated area, its cells showing considerable desquamation and leucocytic or purulent infiltration. The base of the ulcer is richly infiltrated with edema and with inflammatory cellular infiltrate, around the borders of which there is considerable hemorrhage. The inflammatory cellular infiltrate at the base of the ulcer consists mainly of leucocytes and swollen plasma cells, many of which, particularly near the surface, are degenerating or necrotic and mingled with much cellular detritus. In the deeper portions of this ulcerated base, and about the sides the blood-vessels are injected and a new capillary formation has taken place. Here and

there are patches of a reticular fibrin. As already noted, the Gram stain showed that the mucous membrane is rich in staphylococci, many of which are in the phagocytes.

Figure 30, therefore, shows ulceration of the mucous membrane with a necrotic base surrounded by hemorrhage. Figure 31 demonstrates the hemorrhage and inflammatory infiltration containing numerous phagocytes.

Case 21. A man, 51 years old; a glass polisher. Autopsy, April 6. He died of cirrhosis of the liver and arterio-sclerosis. There was erysipelas of the soft tissues of the nose the shape and size of a large butterfly. This man first noticed the cirrhotic symptoms 9 months before his death. The erysipelas of his face began 2 days before death, spreading rapidly over the nose. All of the mucous membrane of the nares and all the sinuses were intensely inflamed. The mucous membrane of the frontal sinus was the least affected. I took a specimen from the sphenoid, both antra and the anterior end of the middle turbinate on the right side. There was a well-marked empyema of the right antrum.

Microscopically the mucous membrane of the right maxillary antrum shows in the epithelial layer a great deal of desquamation particularly over the principal focus of suppuration where ulceration has taken place, and the tissues about the pus-collection are generally necrosed. There is more or less hemorrhage and vascular injection through the tissue.

The mucous membrane of the left maxillary antrum: The general membrane is but little swollen. The epithelial surface is corrugated. The epithelial lining is generally preserved and rich in goblet cells. The edema of the sub-epithelial tissues is but slight and there is comparatively little inflammatory change. The blood-vessels are moderately injected. Hemic pigment is of slight amount, for the most part contained within the phagocytes. The blood-vessel walls are without appreciable change. The mucous glands are numerous and relatively unchanged. The left antral mucous membrane shows a little pigment and some slight edema. The frontal sinus mucous membrane is almost normal. There is only a certain richness of goblet cells in the epithelium. The right middle turbinate in the anterior end shows some slight inflammation and very vivid secretion.

Briefly: The right antral mucous membrane shows sub-mucous suppuration surrounded with edema and hemorrhage. There is cystic dilatation of a duct filled with pus-corpuscles, (see Figure 32).

The Gram stain shows streptococci. The sphenoid shows only a little edema.

Case 22. A woman, 38 years old; a housewife. Autopsy, May 7. She came to the ear clinic March 25 with otitic symptoms. An aurist saw her in the autumn of 1908, when she had purulent rhinitis. She died of sepsis from an acute suppurative otitis media on the left side for which she was operated upon twice. The first operation, of May 1, consisted in opening the mastoid cells. A second operation was performed on May 5, opening up the abscess of the brain posterior to the mastoid cells. Both these operations had a negative result.

There was a left-sided chronic empyema of the maxillary antrum due to a carious first molar tooth. There was also empyema of all the ethmoidal sinuses on the left side and edema of the sinus sphenoidalis. The brain only showed hyperemia.

I removed two pieces of the antral mucous membrane as well as some mucous membrane from the posterior ethmoid and sphenoidal sinuses. The frontal sinus on both sides was normal. On the left side the anterior ethmoidal cells extended outward parallel with the frontal, and when their shell was broken open, much muco-purulent material escaped. There was a large accessory opening for the maxillary antrum on the right side.

It is said that a distinguished rhinologist had pronounced this woman's antrum normal or free from any evidences of empyema a few days before her death, and that another rhinologist shortly afterwards finding pus in her middle meatus, had made a diagnosis of ethmoiditis by exclusion, the second rhinologist having been supplied with the above information and having also been told that an X-ray photograph showed the frontal sinuses to be in normal condition.

Microscopically the mucous membrane is thickened by diffuse cellular inflammatory infiltration. The epithelium is practically universally lost. In places the exposed tissues are necrosed, although not definitely caseous. The inflammatory infiltrate in the tissues consists mainly of lymphocytes with some leucocytes and plasma cells, and a great number of endothelioid cells. Mixed with these are a few typical Langhans' giant cells or tubercular giant cells. In one or two positions special focalization of these endothelioid cells gives evidence of an attempt at the histological structure of tubercles. There is a considerable amount of edema with occasionally a small amount of fibrin in addition to the cellular ele-

ments just mentioned. Very much the same condition of affairs exists in the mucous membrane of the ethmoidal sinus with special foci of caseation. A special staining-process and repeated careful search failed to show any evidence of tubercle bacilli.

The type of tuberculosis met here is rather one of acute, diffuse, exudative and proliferative tuberculosis than that type in which the ordinary nodules of the disease are formed.

The sphenoidal mucous membrane shows practically the same condition with a low degree of infiltration of the connective tissue and goblet cell formation.

Dr. Wiesner found in the heart's blood, at the autopsy, staphylococci, showing that she died chiefly of toxemia and bacterial poisoning.

Case 23. A woman, 69 years old; a housewife. Autopsy, May 13. Clinical diagnosis was uremia, chronic parenchymatous nephritis, hypertrophy of the heart and lobular confluent pneumonia.

There was edema bullosa of the left sphenoid and right maxillary antrum. There was chronic edema of the left maxillary antrum and flakes of pus. I removed part of the posterior portion of the left maxillary antrum intact for examination.

Microscopically the mucous membrane is generally thickened. The epithelial layer is preserved and, aside from a slight leucocytic infiltration, is normal. The superficial part of the sub-epithelial connective tissue is richly infiltrated with plasma cells, lymphocytes and a few leucocytes. There is cellular infiltration, less marked in the deeper portions of the membrane. In the latter part the tissues are more definitely fibrous but loose from edema. The blood-vessels in this deeper portion are thickened from sclerosis. The capillaries of the superficial layers are injected and their endothelium swollen. Scattered phagocytes contain hemic pigment granules only in certain sections. There are mucous glands present.

This case, therefore, was an example of chronic edema and inflammation of the left maxillary antrum.

EXAMPLE OF AN ALVEOLAR OR DENTAL CYST.

Case 24. A man, 48 years old; a key-maker. He entered the hospital February 13. He died May 7, and the autopsy was performed on the day he died. The clinical diagnosis was carcinoma of the intestines with metastasis to the liver. His carcinomatous liver was enormous.

When the roof of the mouth was broken open about its middle in exposing the sinuses by our routine method, a large soft cystic

tumor was seen in the alveolar floor of the right antrum. See macroscopic drawing of this specimen, Figure 43, in which we are looking at the cystic tumor from before backward. The alveolar process was extremely thick. This dental cyst did not communicate with the antrum from which it was separated by a thin paper-like layer of bone and mucous membrane, nor with the oral cavity. Both antra were very large.

Microscopically the cyst is lined with a layer of stratified squamous epithelium varying in thickness in different portions. In this epithelium lie certain bodies of a rounded or irregular lobulated shape with concentric structure and nearly hyaline substance. (See Figure 44.) Upon close examination these concentric lamina show indefinite striation; the body suggesting rather an irregular keratin formation than keratinization. These bodies take a strong eosin tint. In a few positions the epithelium of this lining sends out epitheliomatous-like projections into the surrounding tissue, and occasional islands of the epithelium lie isolated in the section, (see Figure 44 at C.), which are probably the result of the cutting of branches as they pass at an angle through the plane of section. Close inspection shows the presence of prickles from this epithelium.

The sub-epithelial tissue is a fairly dense fibrous tissue on the outside of which the wall shows more or less degeneration. In this wall, close to the epithelium, there are occasional areas of lymphocytic infiltration, and throughout the fibrous coat there is the scattered occurrence of coarse, brownish hemic pigment granules. The contents of this cyst are of a cheesy character, showing numerous clefts in which originally cholesterol probably existed. (See microscopic drawing shown in Figure 44 at A.) The tumor proves, therefore, to be a dental cyst lined with squamous epithelium. The filling mass is rich in cholesterol. The lining epithelium sends out carcinoma-like projections as already noted with rudimentary cornification in several places. The outer surface shows cholesterol masses which may have been deposited either by the bursting of the cyst during its removal or preparation. There is erosion of the alveolar process in contact with the cyst wall (Figure 42).

EXAMPLES OF RETENTION CYSTS.

Case 25. A man, 26 years old; superintendent of a steam saw-mill. Autopsy, April 5. Clinical diagnosis, tuberculosis of the larynx, lungs and intestines. This patient entered the hospital on March 21.

The frontal sinuses on the right side extended outward $3\frac{1}{2}$ cm. and 3 cm. vertically. On the left side outward 3 cm.; laterally 2 cm., while the horizontal measurement for both was $2\frac{1}{4}$ cm. There were enormous sphenoidal sinuses, with two vertical portions (see Figure 33) extending into the greater wings of the sphenoid. They measure 6 cm. from side to side; and from before backward $3\frac{1}{2}$ cm.; the right antrum $5 \times 5\frac{1}{2}$ cm. (antero-posterior and vertical diameters). This right antrum contained a small cyst on the nasal wall the size of a small pea. The left antrum measured 4 by $5\frac{1}{2}$ cm. The specimen to show this cyst was secured and placed in Mueller's solution (two parts) and formol (10 per cent solution) one part. All tissues removed from the sinuses were treated in the same way.

Microscopically the mucous membrane is slightly thickened. The epithelium throughout is intact including numerous goblet cells. The cilia are present. The sub-epithelial connective tissue is densest in its deepest portions, shows a slight degree of edema more superficially and contains a considerable number of mucous glands throughout. The blood-vessels are comparatively thick-coated and their walls somewhat fibrosed. The veins appear to have been distended probably from chronic inflammation. Especially in the superficial portions about the blood-vessels and glands there is a moderately rich infiltration of lymphocytes. In one situation there is a shallow depression of the surface with narrow mouth and widened base which may possibly represent a section through a much widened duct in the course of the development of a retention cyst. If such be the case the contents have escaped, and while the close relationship with many of the glands conforms with this idea of cystic development, the appearance could easily have been produced from a papillomatous or villous projection of the surface over the depressed space at the plane of the section; the fact that there is no special goblet cell-formation, more marked than in the general surface of the mucous membrane, being an argument in support of this view. This cyst appears, therefore, only as a recess or diverticulum of the mucous membrane which might be a dilated duct, especially as it is surrounded on both sides by a large amount of mucous glands. The contents of the cyst have escaped.

Case 26. A man, 40 years of age; a bookkeeper. Autopsy performed April 7 by Dr. Erdheim. Death due to dermoid cyst of the mediastinum and secondary carcinoma of the lungs, pleura, liver, etc. This patient entered the hospital March 1, in the service of

Professor Schlesinger. In this case there was a tumor the size of a small walnut projecting into the cavity of the right antrum from the anterior third of its nasal wall obliterating the natural opening of that sinus. See photograph of the specimen (Figure 35) and a drawing of the microscopic condition (Figure 37).

Microscopically the mucous membrane is made up of very loose fibrous connective tissue containing numerous connective tissue corpuscles. There are a few blood-vessels and these are thin-walled, distributed through the tissue. Covering the connective tissue there is a layer of ciliated stratified columnar epithelium. This epithelium is thinned out into a single layer of flat cells, deprived of their cilia in several places.

This tumor proved to be a multi-locular cyst. The ciliated epithelium lining the antrum shows in the protoplasm above the basal membrane in some places densely grouped yellowish pigment granules with a small amount of light refraction. Both sorts of granules gave the iron reaction and therefore are proved to be of a hematogenic nature. In some parts of the sub-mucous connective tissue there are groups of phagocytes whose protoplasm contains similar but coarser granules of the same color and refracting properties. The inner surface of the cyst is lined with ciliated epithelium containing very numerous goblet cells, see Figure 37.

Case 27. A man, 67 years old; a post-office official. Autopsy, April 13 by Dr. Bartel. He died of heart disease and incarcerated hernia on April 12. He was also a case of hypernephroma. His sinuses were of average size. The left antrum showed a small retention cyst in the middle line of the nasal wall, for which see drawing (Figure 39). This specimen was removed for microscopic examination. The left antrum measured 4.3 cm. from behind forward by 2.5 cm. laterally and 4 cm. from above downward.

Microscopically the mucous membrane is thin and composed mainly of dense fibrous tissue; its blood-vessels are moderately thick-walled from sclerosis; its epithelium, save where lost from *artefact*, appearing to be normal. In one situation there bulges above the surface a small cyst between 1 and 2 mm. in diameter, lined with a layer of columnar cells which in places retain their cilia, but which generally are slightly lower than the cells of the surface. The contents of this cyst have been lost. At the base of this cyst in the connective tissue are a number of sections of a mucous gland showing atrophic changes from pressure contrasting

in size with several other glands in the section away from the cyst which are of normal appearance.

Case 28. A woman, 56 years old; a servant. Autopsy performed by Professor Stoerk, April 24. Clinical diagnosis, "Carcinoma in der Gegend Papilla Vateri" (duodenal valve). The woman had been emaciated and jaundiced. The cause of death was tubercular pericarditis.

There was a large sphenoidal cavity with a very thin and transparent posterior wall, measuring on the left side $3\frac{3}{4}$ cm. by 2 cm.; on the right side $3\frac{1}{4}$ cm by $1\frac{1}{4}$ cm. The antra and the frontal sinuses were very large. In the anterior one-fifth of the roof of the right antrum there were two very small, yellowish-white bodies, about the size of millet seeds, which were removed for microscopical examination. Both middle turbinates were cystic in the anterior end.

Microscopically the mucous membrane is very thin and made up of dense fibrous tissue. The blood-vessels are slightly sclerosed. The epithelium is practically entirely lost from the surface. There are no glands in the section but there are two small epithelial-lined cysts almost microscopic in size. These cysts are less than 1 mm. in diameter. Both contain a structureless eosin-stained material, in the one case perfectly homogeneous, and in the other faintly striated. The remaining cells of these cysts are made up of a single layer of the low columnar type, some of these cells being desquamated and lying in the contents of the cyst. This was the only case where there was any response to the mucin reaction.

Case 29. A woman, 28 years old; a housewife. Autopsy, May 4. She died of traumatic sepsis from a pitchfork wound accidentally inflicted on the uterus and vagina. Both antra were very large. On the nasal wall of the right antrum there was a cyst 9 by 5 mm., which was removed for examination. All the sinuses were large.

While the *microscopical* appearances were identical with that of Case 30, it is still of interest to note the following details: The mucous membrane is generally thin. Its sub-epithelial tissues are fibrous and relatively a-cellular. Its blood-vessels are thick-walled from fibrosis. There are very few atrophic gland-structures shown in the section. The epithelium over the entire outer surface of the cyst has been largely lost. The epithelium towards the base of the cyst and over the rest of the section is retained, and almost

universally the site of mucoid change, that is to say, goblet cell formation.

A cyst with a coronal diameter of about 7 mm. projects 5 mm. or more above the surface of the surrounding membrane. In section it shows a uni-locular cavity containing scant faintly eosin-tinted material precipitated in fixation and is lined with a single layer of columnar cells, usually flattened to cuboidal or lower shape. In a portion of the lining-membrane the ciliary processes are apparently preserved.

Case 30. A woman, 28 years old; a housewife. Autopsy, May 7. She died of endocarditis, old mitral insufficiency and old phthisis pulmonalis of the upper lobe of the right lung. There was a large retention cyst in the right antrum 9 mm. in diameter and a small one about 3 mm. in diameter on the left antral floor. See photograph shown in Figure 38 and drawing shown in Figure 41.

Microscopically the mucous membrane is generally thin and made up of a dense and relatively a-cellular fibrous tissue. The epithelium is mostly preserved and without abnormalities save the presence of a moderate number of goblet cells. Close to the cyst to be described later the mucous membrane is thrown into numerous small villous projections. The cyst which projects above the mucous membrane for 6 mm. measures in transverse diameter 9 mm. It has a very thin wall lined with a single layer of columnar epithelium which is non-ciliated and flattened from pressure. The contents are a homogeneous structureless hyaline material stained pink from eosin. Close to the base of this cyst are a number of atrophic glands and nearby a duct slightly distended. Other atrophic glands are met in the fibrous tissue at some distance, these also being accompanied by a somewhat distended duct. The blood-vessel walls of this section show no appreciable sclerosis, but the veins are prominent as if from a passive congestion.

The larger cyst proves to be a retention cyst with atrophic lining, while the small tumor on the left side proves to be a multi-locular cyst. There is a dilated duct below the mucous membrane in contact with this latter cyst.

Case 31. Woman, 30 years old; a servant; died of cerebro-spinal lepto-meningitis. There were two small retention cysts in the roof of the right antrum anteriorly. (See Figure 40.) The mucous membrane is very thin. Its general structure is fibrous loosened by edema. The surface epithelium is rich in goblet cells. The glands close to the cyst wall are atrophic in appearance and

show mucoid degeneration in many of their epithelial cells. The blood-vessels are comparatively thin-walled and engorged with blood.

The cyst in this specimen consists of several loculi from which the contents have been lost, but there is sufficient remnant, however, to show its colloid-like type. The cyst loculi are lined with columnar epithelium, which in places shows goblet cell change, but which for the most part are more or less depressed, even to flattening, by the internal pressure upon them. This specimen, like the others, gives evidence of chronic atrophic catarrh. The antral retention cysts show vivid secretion of the surface, with almost a continuous row of goblet cells.

Case 32. Man, 26 years old; a boss-machinist. Autopsy, May 10. The clinical diagnosis was purulent meningitis following otitis media, which had been operated upon. The autopsy showed an abscess of the occipital lobe of the brain to have been the cause of death. The sinuses were normal in size. There was a small retention cyst near the floor of the left antrum on the nasal wall $1\frac{1}{2}$ cm. by 2 cm. in diameter. The posterior wall of the sphenoidal sinus was so thin as to be transparent. Did not remove any tissue for microscopical examination.

Case 33. Man, 77 years old. Autopsy, May 10. Clinical diagnosis, lobular pneumonia. He was in the hospital only 12 hours. There was pus in both sphenoids. A culture was made of this pus and it was found to be rich in the diplococcus of pneumonia. Whether this sphenoidal infection preceded or followed the pneumonia it was impossible to determine. The antra was very large. The right maxillary antrum showed a dark multi-locular cyst on the floor of that cavity and a large white cyst on the posterior wall of the floor. The latter had caused erosion of the antral floor. (Figure 42).

Microscopically the membrane is slightly thicker than normal and the site of several closely situated cysts, the largest one of which measures in its flat or coronal diameter 11 mm., while in height it is only 4 mm. Two other minute cysts lie in close proximity. The epithelium of the surface of this mucous membrane is generally preserved, but the number of strata in the layer is much diminished, and the cells thus depressed in height over the convexity of the cysts, being almost cuboidal. The cilia are preserved. The sub-epithelial connective tissue is loose from edema and contains a number of mucous glands, many of which show

slight distention and contain an eosin-tinted homogeneous material like that in the cysts proper. All of the cysts are filled with this same colloid-like substance and have their fibrous walls lined internally with a single layer of cuboidal to flat epithelium. The larger cells are commonly provided with cilia and are generally more or less loaded with fine brown, hemic-pigment granules. There are no important changes in the blood-vessel walls. In other words, below the large antral cyst there is a much smaller one, and below that again, lined with the same sort of atrophic epithelium a cystic formation of part of a duct. This specimen shows the formation of a multi-locular cyst out of several parts of one and the same duct corresponding to several loops of its convolutions. To the right of the chief cyst there is a small one with very thick contents.

Case 34. Man, 39 years old; a night watchman. Autopsy, May 12. He died of hemorrhage of the brain, arterio-sclerosis and chronic nephritis. The autopsy showed a very large hemorrhage into the right cerebral hemisphere involving the internal capsule. He had an unusually thin skull. There was an old hemorrhage in the left antrum and sinus sphenoidalis. In the left maxillary antrum, on the nasal wall, there was a retention cyst which I removed. *Microscopically* the specimen showed the usual formation of retention cyst such as has been already described.

Case 35. Woman, 64 years old; a housewife. Autopsy, May 12. She died from fracture of all the ribs except the first on the right side and the seventh on the left. She was very fat. All the sinuses were large. On the floor of the left maxillary antrum were three small retention cysts and a mild edema bullosa with clear white walls; not brown or greenish-brown in color, which is their usual appearance.

Case 36. Woman, 22 years of age; a servant. Autopsy, May 13. She died of peritonitis following abortion. The frontal sinuses were very small, the antra large. There was a retention cyst on the roof of the right antrum about the middle or at the angle between the roof and the nasal wall. There was erosion of the bone below the retention cyst of the right maxillary antrum.

Microscopically the appearance was very similar to that found in Case 33; the large retention cyst giving the characteristic picture. There was also another and a much smaller one which was most probably an early stage of cyst formation from a dilated duct.

Case 37. A woman, 42 years of age, a housewife. Autopsy, May 13. The cause of death was epidemic cerebro-spinal meningitis, acute nephritis and phthisis pulmonalis.

All the sinuses were normal. There was a retention cyst on the nasal wall of the right maxillary antrum measuring 8 mm. by 9 mm. This specimen was not preserved.

CAUSE OF DEATH.

Of this series of 37 cases, tuberculosis, pneumonia, carcinoma, sepsis, heart, and blood-vessel disease, each claimed 5 victims, thus accounting for 25 of the cases. Among the remainder, 3 died of cerebro-spinal meningitis, 2 of nephritis, and 2 of leukemia.

It is only logical to surmise that the death of the patient was hastened in a large proportion of these cases by the presence of inflammation in the antral mucous membrane. In a number of these cases this inflammation was accompanied by the formation of considerable pus. Frequently one or more of the antra were filled with pus, the presence of which had not been recognized during life. As examples of cases where this antral empyema may have had a very active part in causing death, let me call attention to numbers 12, 13, 14, 15, 16 and 22. In several of these cases the patients died of pneumonia long after the formation of this antral pus. No attempt was made to make any systematic search for tubercle bacilli as I relied more on the microscopic sections than on any bacteriological studies.

SUMMARY OF MICROSCOPICAL FINDINGS.

1. Several slides show only hyperemia and edema representing the early stage of inflammation in this series.
2. Next there are a number which show actual suppurative inflammation. These generally show more or less well-marked epithelial desquamation, infiltration of leucocytes into what remains of the epithelial layer and generally only a moderate mucoid degeneration of the persisting epithelium. The sub-epithelial tissues are injected, and at times, hemorrhagic. They are loose from edema and occasionally show small deposits of fibrin and enlarged lymph spaces, together with poly-nuclear leucocytic infiltration, the presence of numerous mono-nuclear leucocytes, and often a well-marked occurrence of eosin-stained plasma cells. In individual examples distinct focalization of the leucocytes marks the occurrence of minute abscesses. Commonly there is swelling, of the endothelium, of the blood-vessels and of the lymph spaces. Occasionally

young connective tissue corpuscles developing into fibro-blasts occur in these sections. The glands are not always changed, but several specimens show special pus collections in dilated ducts.

3. A third group shows a chronic inflammatory process sometimes with thinning, but often with thickening of the mucous membrane. In both cases the epithelium shows an excessive number of goblet cells. This third group may properly be divided into two sub-groups, namely: a, the atrophic; and, b, the hypertrophic form.

a. In the atrophic form the epithelial layer is usually reduced in the number of strata and the cells are often lowered in height; this lowering or pressing downward of the cells being especially likely to occur over prominences. The cilia are not always lost but may be to a greater or less extent. There are generally examples of mucin-bearing goblet cells among them.

The sub-epithelial tissues are fibrous and commonly are rather dense, although a slight edema may occasionally prevail in parts of the membrane. The blood-vessels frequently show a sclerotic thickening of their walls. Hemic pigmentation occasionally exists and the glands are either unchanged, atrophic or not infrequently cystic.

(b) In the hypertrophic form the epithelium is retained and is generally rich in goblet cells, ordinarily of normal size and with persistent cilia. The surface of the mucous membrane is apt to be irregular and sometimes thrown into distinct papillary projections. The sub-epithelial tissues here are fibrous but show a higher proportion of cellular elements than in the preceding variety. Fibro-blasts are usually frequent, while plasma cells and mono-nuclear leucocytes are generally present, at least, about the glands and the blood-vessels. Edema may also occur here but is usually only of moderate extent. Sclerosed arterioles are not uncommon. The veins are apt to be injected and hemorrhagic pigmentation also occurs. The mucous glands may be either unchanged, atrophic or cystic. There is no example of hyperplasia or hypertrophy occurring in this series.

CYSTS.

The retention cysts in this series occur regularly in connection with chronic inflammation, apparently more frequently in the atrophic than in the hypertrophic form. They vary in diameter from minute size to a centimeter or more. They are commonly filled with a homogeneous, structureless, eosin-stained material which, from its staining reaction, is evidently not true mucin. Case No. 28 is the only example in which true mucin reaction took place.

The nature of this is not clear, but the appearance suggests pseudo-mucin or some material approaching colloid. This material differs from colloid in taking the eosin tint more faintly than is usual.

The walls of these cysts are invariably thin. They are composed of a scanty basis of dense fibrous tissue and lined by either a single layer of low columnar epithelium or by a thin stratified layer of the same type. The cilia are commonly missing, but sometimes are demonstrable. Atrophic changes in closely lying gland structures are common. These changes are probably due to pressure. Now and again these cysts are multiple and from the coincident appearance of partly dilated ducts, in proximity to the cysts, the idea of multi-locular distribution of the duct of a single gland may be considered in the production of this type of cyst. Case No. 28 has been thought to illustrate the development of a cyst from a dilated duct.

DEDUCTIONS.

In reviewing the data secured from the detailed histories and microscopical findings in these heads selected from a series of 100, as already mentioned, one is struck with a number of interesting facts:

1. The great frequency with which the maxillary antrum was affected, or in 37 per cent.
2. The great number of undiagnosed cases of empyema, about 10 per cent. Of these examples of overlooked empyema, Case No. 22 is the most striking example. In this case three specialists seemed unable to diagnose during life a case of double antral empyema.
3. It seems logical to conclude that in a number of these instances the antral condition might easily have been the cause of death. This assertion is based almost entirely on the duration, of the inflammatory condition as shown by the microscopic examination.
4. The relatively unimportant role played by either the age or the occupation of the patient. No age was exempt and no occupation, in my series at least, seemed particularly to predispose to antral inflammation.
5. The great number of retention cysts; occurring in 13 per cent of the cases. That these cysts are formed from a dilated duct of a mucous gland there can be no question. In my series of microscopical sections and in the drawings accompanying this article the mechanism of cyst-formation may be worked out step by step.

6. The decided proof of chronic atrophic inflammatory conditions attending the formation of these retention cysts which are shown in my microscopic specimens. In every case where a specimen was prepared of the mucous membrane in the neighborhood of one of these cysts, undoubted evidence of chronic inflammation was present under the microscope, although there was no evidence of inflammation macroscopically. Dr. Hajek,²³ in his book refers to a case where the entire antrum was filled up by these retention cysts.

7. The apparent freedom from involvement of the sinuses in patients who died of tuberculosis, that is, in my series of 100 heads. In this series there was only one case, Case 22, where there was any evidence of tuberculosis in the mucous membrane of the sinuses, although 21 of my autopsy series died of tubercular affections.

8. Duration of the Inflammation.—From the microscopical appearances of the sections the time of duration of the various inflammations present may be briefly summarized as follows:

A. The cases of edema and hyperemia were a matter of only a few days.

B. The examples of empyema or chronic inflammation were of uncertain duration, but it may be taken as an assured fact that those showing the late features of inflammation with epithelial exudate, etc., were of several months duration, while those of a milder form probably lasted only a few weeks. Cases of chronic catarrh must have lasted for months.

In this series of cases there happens to be no example of a neoplasm or tumor with the single exception of the dental cyst noted in Case 24.

Sarcoma of the maxillary antrum is rare. Cylindroma and squamous carcinoma are comparatively more frequent. Either the latter develops from a metaplasia of the ciliated squamous epithelium or from a dental cyst protruding into the antrum. Sometimes a fibro-sarcoma may develop. Examples of such a neoplasm are comparatively rare in the routine work of the autopsy room. Retention cysts are of frequent occurrence, as has been frequently pointed out and corroborated in my series.

These retention cysts never appeared on the outer wall of the antrum. Invariably they were found to occupy a position either in the floor, the roof, or the nasal wall of the antrum, preferably in proximity to the ostia. In other words, these cysts were found in

the places where the mucous glands were most richly distributed, as already referred to.

It seems reasonable to conclude that retention-cysts are of more common occurrence in the antra than in the histologically similar mucous membrane of the nose; first, because of the greater secretive activity of the glands in the latter situation; second, because the entrance and exit of the air in the nares normally acts as a pump upon these glands. The drawing shown in Figure 45 is a diagram of a mucous gland, (a) representing the duct and (b) the acini. The mechanism of the formation of a retention cyst is that secretion may be dormant for a day or two in the antral glands and the secretion lying in the lumen of the duct (a) becomes so thickened as to form a plug. In consequence the duct is dilated when secretion is established in a bottle-shaped form and a cyst is



Figure 45.
Diagram of a mucous gland.

inaugurated. This is well shown in specimen 16 (of which see drawing, Figure 27), and clinical evidence supports this view.

9. *Edema bullosa*, or fluid in the sinuses. In illustrating such cases let me mention Case 3, where in a very large antrum there was a mucous cyst or bubble the size of a 10-cent piece which collapsed on the touch of a probe. This condition we called "*edema bullosa*," and disregarded from a pathological standpoint. At least a dozen cases were examples of this condition, but needless to say, they have not been included in my series.

Anatomical data. In this series of 100 cases measurements of the transverse diameter of the skull were made in 66. This measurement was taken between the tips of the divided greater wings of the sphenoid parallel with the roof of the sphenoidal cavity. The smallest measurement was secured in Case 33, where it was 11 cm.; the largest measurement in Cases 82 and 84, where it was 15 cm. The average transverse diameter of the 100 heads examined by the Harke-Ghon method was 13.53 cm.

Accessory antral openings were noted only in Cases 17, 19, 28 and 72, or in other words, only in 4 per cent. The usual percentage where these openings are present is given by most observers as considerably higher. Dr. J. E. Schadle¹⁸ found in an examination of 80 heads that 47 per cent showed accessory openings, and in 26 per cent of these the ostia were very large. In another series that he examined with Professor Onodi, fully 50 per cent had these supplemental orifices.

It has been said that a case of antral empyema occurred in a child shortly after birth, but I have not been able to find a reference to this case. Dr. John H. Foster¹⁷ reports an example of empyema of the maxillary antrum in an infant $3\frac{1}{2}$ weeks old. There was empyema of both antra due to rhinitis. The child was under observation for over a month, gradually grew worse and finally died of septicemia. This case was not operated upon and the antral pus burrowed under the eye-ball into the middle meatus and also through the alveolar processes.

As illustrating the importance of a prompt diagnosis let me quote the case reported by Dr. Carl Reitter.⁶ A maid servant, 21 years old, developed empyema of her maxillary antrum from a nasal polypus. Peritonitis and death ensued in 11 days after she came under observation. No operation had been performed on this case.

As illustrating the frequency with which antral inflammation occurs, I would refer to the report of Dr. H. Tilley. In 1903, he saw 52 cases of antral suppuration. Of these, 4 were acute and 48 were chronic. Of these 15 showed combined chronic suppuration of the frontal, ethmoidal, and antral sinuses. In 4 other cases the sphenoidal sinuses were simultaneously affected with one or more of the last-mentioned group.

DIAGNOSIS.

In cases which present no external evidence of antral inflammation, the intra-nasal diagnosis is often a very tedious one, because it is always a diagnosis by exclusion. If there is pus persisting in the middle meatus which when it is wiped away reappears within a minute or two, the possibility of the frontal sinus being the cause of the pus formation must be looked into. If at the first examination of the patient presenting the condition above noted, the frontal sinus can be probed, washed out and eliminated as a causal factor, much has been accomplished. In a similar way the anterior ethmoidal sinuses may be eliminated at a second visit. At the third visit when these sinuses have been excluded it may be an easy mat-

ter to demonstrate the presence of pus in the antrum, or it may be a difficult one.

Ziem's symptom was the first diagnostic sign of empyema. He demonstrated in 1881 that in such cases pus may run from the antrum upon the patient's leaning forward or inclining the head toward the unaffected side. Therefore, after cleaning out the middle meatus and allowing the patient to rest for 10 minutes, if pus should again appear in decided quantity, it must then be regarded as a case of antral empyema. This, of course, is true only when the frontal and ethmoidal sinuses have been excluded as possible factors.

There are two kinds of antral empyema: First, that due to carious teeth, which is about 10 per cent of the cases; and, second, that due to infection from the nose, which produces the remaining 90 per cent. The diagnosis of the first class of cases is much simpler than that of the second, for obvious reasons. An empyema always points inward, following the line of least resistance. Where a case is of long standing and has given rise to a facial cellulitis the diagnosis is rendered much more obvious. It is the cases in which there are only mild intra-nasal symptoms that present any difficulty. Certain it is that the series of cases herein reported call attention to the fact that antral empyema is very frequently overlooked. That this neglect is dangerous there can be no question. An X-ray photograph of a case is often of the greatest assistance, not only in determining whether or not pus is present in the antrum, but also in throwing light on the anatomical conditions present. Trans-illumination is also of value but cannot always be depended upon. The simplest, the safest and the best procedure of all is the introduction of the trocar and cannula in doubtful cases. The use of this instrument will be spoken of again later. Experience shows that the doctor who makes the most punctures finds the greatest number of empyemas.

ETIOLOGY.

The causes of antral inflammation may be divided into general and local. Under general causes there would be influenza, pneumonia, syphilis, diphtheria, measles, the exanthema, and other infectious conditions accompanied by catarrhal affections of the respiratory tract. Under local causes, unhealthy intra-nasal conditions, such as hypertrophies, especially of the middle turbinate, irritating spurs and deflections of the septum causing frequent at-

tacks of rhinitis. The latter may, however, be a sequel to the accessory sinus disease.

DENTAL CYSTS.

These cysts, as they develop, bulge out the alveolar process toward the oral cavity. Such a cyst usually perforates over the canine tooth and is an occupant of the canine fossa. They may be of two kinds, either composed of mucous membrane, or of bone. If bony, they may be inflammatory, or congenital. This is easily understood when we remember that a tooth develops from two processes or dental sacs. In a new-born child, moreover, in each alveolar process there are two mucous membrane sacs, from one of which a milk-tooth develops, and from the other a permanent tooth.

As an alveolar or dental cyst develops there may be a swelling either in the hard palate or more likely, in the inferior meatus of the nose. Gerber's diagnostic sign is a tumor in the lower meatus and "paper crepitation." This latter crepitation is also sometimes spoken of as "egg-shell" crepitus.

Such a cyst is lined with squamous epithelium and presents the characteristics on microscopic examination shown in Case 24. The contents of a congenital cyst which is always subjected to considerable pressure may be either pus, serum, or cholesterin in solution.

In addition to the case just mentioned I had a well developed example of such condition in an anatomical specimen given me for dissection. The head was that of an adult white male. The cyst presented in the left canine fossa and was about the size of a nickel. It demonstrated Gerber's sign and on being ruptured its contents proved to be cholesterin in solution.

In neither of the two cases of dental cyst, which I have seen, had there been any marked symptoms observable by the patient, nor had they apparently suffered any inconvenience from their presence.

TREATMENT.

The earliest operations on the maxillary antra were performed by dentists accidentally. Surgeons naturally followed suit, so that the first operations have been described by the alveolar route. The main objection to entering the antrum by this route is the trouble that is frequently encountered in causing the alveolar fistula to close. It is always better, therefore, either to puncture or to perform a radical operation on the antrum through the nasal wall. It is an excellent rule never to attempt to enter the antrum through the socket of a canine tooth; and, again, if the alveolar operation should be insisted upon by the patient, it is well to examine the

canine fossa carefully, and if very deep, this anatomical condition is a contra-indication to operation.

Ordinarily in antral inflammations simple puncture with repeated flushing out of the cavity is sufficient to establish a cure. The instruments needed for this very simple procedure are shown in Figure 46. The outer wall of the inferior meatus having been previously cocaineized on the affected side, the point of the trocar and cannula is introduced $1\frac{1}{4}$ inches from the anterior nasal spine through the nasal wall. This partition between the antrum and the nares is so thin that but little force is necessary for its proper introduction. Either a straight or curved instrument may be used. Particularly in patients with a narrow jaw a preliminary examination of the canine fossa should be made as a routine practice, so as to guard against any possible anatomical abnormality.

After the introduction of the trocar and cannula the sharp-pointed instrument is removed, and the rubber tube fitted into place. The syringe to be used for flushing out this cavity should then be filled with air and the latter forced through the tube. This preliminary syringing with air should be done as a routine practice in order to prevent either puncture of the canine fossa or of the orbit. If this air should be forced into the antrum it can readily escape through the ostia. If it should be forced into the soft tissues of the face or orbit it would disappear gradually without any resulting cellulitis. If, however, the normal salt solution should have been introduced immediately without the preliminary introduction of this air, and find its way into these soft tissues a very troublesome cellulitis might result. At all events, the subsidence of an injection of such a solution would be much longer than the emphysema referred to above.

While every precaution should be taken to secure thorough sterilization of the instruments it is impossible to render aseptic the field of operation when either the intra-nasal or the oral route is taken.

While some operators prefer to enter the antrum through the middle meatus in puncturing this sinus, the main objection to the selection of such a route is the proximity of the orbit. It is much safer, therefore, to enter the antrum through the processus maxillaris of the inferior turbinate bone, or in other words, through the easily accessible portion of the nasal wall on a level with the lower border of the inferior turbinate.

Ordinarily puncture and lavage is sufficient to establish a cure in the majority of these cases of antral inflammation as the mucous membrane of that cavity has great recuperative properties. If, however, after the lapse of 3 or 4 weeks a free discharge of pus from the antrum continues, it becomes necessary to resort to some more radical procedure. The first radical operation to be recommended is an enlargement of the opening already made for the puncture. By this method an opening should be secured large enough to admit the index-finger of the operator. Any one of the excellent cutting forceps devised for this purpose may be employed. It is important to make this opening as near as possible to the antral floor and large enough to prevent its subsequent closure. There will still remain a certain small proportion of cases which may require a still more radical procedure, but when the operation just described has been carefully carried out very few cases will require the more radical surgical interference.

The most radical of all the operations is that described by Dr. Hajek²³ in his book under the name of *Lic-Caldwell*. Briefly, this operation, which I have seen performed several times under cocaine, consists, first, in making an incision along the alveolar process through the canine fossa. This incision is from 2 to 3 inches long and is made as high up in the mucous membrane as possible in order to expose the upper part of this fossa. A periosteal flap is then made and a large part of the external and anterior wall of the antrum removed. Care should be taken then to remove the lower part of the nasal process of the maxillary bone so as to allow the making of a subsequent flap of the nasal mucous membrane. Bleeding is controlled by the free use of tampons and the occasional mopping out of the cavity with a 5 per cent peroxide of hydrogen solution.

After the free removal of the anterior wall all of the diseased mucous membrane may readily be removed with a curette, and the cavity thoroughly cleaned out. This having been done and the bleeding, which is never troublesome, controlled, the next step in the operation is to remove all of the bony nasal wall of the antrum. This is the most tedious part of the operation and requires considerable skill on the part of the operator. When this bony part of the nasal wall has been removed there remains nothing but a mucous membrane partition between the antrum and the nares. Through this mucous membrane partition an incision is made along the roof of the antrum and down the sides so as to form a flap continuous with the floor of the nose. This transplanted mucous mem-

brane practically takes the place of the diseased tissues which have been removed. If any small denuded areas remain they are covered over subsequently by outgrowth either from this flap or from nearby areas of healthy mucous membrane.

Finally, the antrum is packed through the large opening in the nares and the terminal part of the packing brought out through the hole in the alveolar process. This method is adopted because when the packing is removed a few days later through this alveolar opening there is no tendency on the part of the packing to tear up the flap. After being thoroughly packed and the end drawn out as described, the oral mucous membrane is sewed up and the operation completed. Even in skilled hands, this procedure requires from one to two hours.

The after treatment covers a period of 3 or 4 months, usually, following such a radical procedure.

It is a good working rule to consider a case of inflammation of the maxillary antrum to have become chronic when it has lasted for 6 weeks. If simple puncture followed by lavage, frequently repeated, fails to cure the case, and if a large opening made into the nares also fails to relieve the condition permanently, the radical procedure which has just been described is the court of last appeal.

In radical operations the diseased mucous membrane must be removed from all recesses or pockets. One of the most unusual of these recesses, and one of the most difficult to treat, is a recess forming in the angle of junction with the nasal wall and the alveolar floor. This is called a *recessus alveolaris*.²³

Very rarely the antrum is divided by a horizontal or coronal septum into two parts, and I have seen but one such case in the examination of over 600 heads. Such a condition is usually due to a displaced ethmoidal cell, or so-called *cellulae Halleri*. A still more rarely-met condition is a *recessus palatinus* where the antrum forms a projection between the palatine wall and roof of the mouth.

The emphysema of the face which is often found accompanying chronic inflammations of the antrum is made possible by the thinness of the orbital wall or roof. While the infra-temporal or zygomatic wall is also very thin, emphysema is not so apt to proceed from this quarter.

LITERATURE.

W. Spencer Watson,¹ in an interesting book of over 450 pages on "Diseases of the Nose and Its Accessory Cavities," refers to 21 cases illustrating injuries and diseases of the antrum. The

majority of these antral cases were examples of chronic inflammation. This book was published in London in 1875 and therefore, somewhat antedates the claim made by some German authorities that rhinology began in their country in 1881. Dr. Watson gives several excellent illustrations of retention-cysts in the antrum, and one or two examples of unerupted molar teeth.

Two other observers have published extensive series of autopsy cases with special reference to the accessory sinuses, namely, T. Hark and E. Fraenkel. Neither of these observers, however, paid any attention to the microscopical findings in their cases.

Harke,³ in 1895, after two preliminary reports, published the results of his autopsy notes on 164 cases. Of these, 56 showed edema, 50 showed empyema and 4 showed retention-cysts in the maxillary antra. Of these cases of empyema, only 4 were of dental origin. In 3 other cases there was an excess of mucous secretion associated with edema bullosa in the sinus maxillaris.

In this report Harke detailed an, at that time, entirely new post-mortem technic for the opening of the skull in order to expose all of the sinuses. The method is as follows:

After the skull has been opened in the usual manner and the brain removed, the skin of the face is stripped back to the orbital ridges and nasal bones, and the scalp along with the muscles of the back of the neck removed as far as the occipital foramen and mastoid processes.

The next step, as usual, consists in opening the middle-ears with a narrow chisel. The skull is then divided with a saw in the median line in front as far as the nasal bones, behind—as far as, and into the occipital foramen. These two cuts serve as guides in sawing through the base of the skull, in doing which the incision is carried as far forward and backward as the skin will permit. As a rule, the saw will deviate slightly from the middle line without any intention on the operator's part, and either the right or the left nasal cavity will be opened before its fellow.

By means of a broad chisel inserted into the frontal portion of the saw-cut, the two halves of the skull are separated and any bridges of mucous membrane that may remain in the roof of the nose and in the roof of the nasopharyngeal space are divided, so as to avoid stripping off the mucous membrane later, when the two halves of the skull cap are finally forced apart. The division of the upper cervical vertebrae, which have been missed by the saw, is then completed with a broad, cutting-chisel, and carried through the middle of the body and arches; as a rule, all that is necessary to do is to bisect the atlas and axis. The two halves of the skull are now firmly held together by the nasal bones, the alveolar process of the upper jaw and the bony palate. The mandible, owing to its articulations, permits sufficient separation of the two halves of the skull; in rare cases the rami of the lower jaw may have to be divided subcutaneously with a "stabbing saw" inserted from behind. The above-mentioned bony attachments can

be separated by a vigorous pull without destroying any important parts, and the separation of the two halves of the skull and of the upper part of the vertebral column is sufficient to afford not only a view of the nasal cavity, but also of the pharyngeal structures as far down as the vocal cords.

The bony palate may, if desired, be divided with a chisel along the line of the nasal septum. In this way the nasal cavity of one side is opened along with the corresponding frontal and sphenoidal sinuses.

In order to expose the nasal cavity of the opposite side the septum is removed by cutting along its base with a pair of heavy scissors. The frontal and sphenoidal sinuses of this side are readily opened as well as the ethmoidal sinuses on both sides. After inspecting the contents and shape of the interior of the nose the middle turbinates are removed either by the scissors or the knife in order to expose the infundibulum. The removal of the inferior turbinates exposes the orifice at the lower end of the lachrymo-nasal duct. By resecting a large piece of the lateral wall of the nose a correspondingly open view of the sinuses is obtained.

I have translated this method of Harke's at some length so that it may be compared in detail with the modification of this method devised by Professor Ghon and myself.

In the following year, or in 1896, E. Fraenkel published another series in which the results were given of 146 autopsy cases with special reference to the accessory sinuses. In this series, 42 were examples of antral inflammation. These cases were divided as follows: Of edema, 18 cases; of empyema, 13 cases; and of cysts, 11 cases. Among the empyema cases only 3 were of dental origin.

The percentage of antral inflammations present in this series of 146 cases reported by Fraenkel was very much the same as the percentage of similar cases in my series of 100. The percentage of cases of antral affections in the series reported by Harke, namely, 164, is very much higher than either of these.

Dr. H. Tilley,⁸ in "Some Observations upon Suppuration of the Maxillary Antrum with Special Reference to the Diagnosis and Treatment," gives a detailed account of 35 radical operations on the maxillary antrum. Of these, 31 made a good recovery. This same writer, in another publication⁹ discusses "Antral Disease in Relation to Special and General Surgery." He takes the very sensible ground that patients suffering from antral inflammations are of equal interest to the general surgeon and to the specialist.

As illustrating the diseases which may simulate, and for a time obscure the correct diagnosis of antral inflammations, let me cite the following cases: Dr. K. K. Wheelock¹⁰ reports a patient who suffered for a long time with an abscess of the maxillary antrum causing symptoms of acute articular rheumatism. Examination of

the pus showed an infection by the pneumococcus which is not unusual in these conditions. Lavage of the antrum cured her promptly, thus illustrating the wonderfully recuperative properties of the mucous membrane of this sinus. Dr. H. Halasz¹⁰ reports a woman, 32 years old, in whom an antral inflammation had lasted for 4 months, producing iritis. When the antrum was punctured and systematic lavage instituted she made a prompt recovery with the disappearance of all of her eye symptoms. Dr. J. E. Schadle¹⁸ has pointed out the intimate relation of antral sinusitis to hay-fever and asthma with special reference to the treatment of 179 cases. He maintains that a secretory antral inflammation forms a characteristic local factor in the production of the nasal and reflex symptoms of the disease.

While the general consensus of opinion as to the relative frequency of the occurrence of dental empyema as compared with that from all other causes is such as has already been stated, it is not without interest to refer to the writings of one who looks at the matter from rather a different point of view. Dr. F. A. Faught¹⁴ has written on "Empyema of the Maxillary Antrum: A Statistical Study." He reviews the main features of 60 cases gathered from dental literature. In these he found that the teeth were the probable cause of 49 of the cases, or 81.6 per cent. All other causes produced only 11 cases or 19.3 per cent. He states that while the second bicuspid and the first molar are the most usual factors in this dental empyema, that any one of the teeth may act as an exciting cause.

As to the selection of a site for operation Dr. Faught found that the cases divided themselves as follows:

Through the alveolus, 42 cases, or 66.6 per cent; through the canine fossa, 11 cases, or 17.4 per cent; through the inferior meatus, 6 cases, or 9.5 per cent. through the root canal, 3 cases, or 4.7 per cent.

In considering this very high percentage of empyemas due to a dental cause it must be remembered that the writer in the above reference deals only with cases which were reported by dentists as having been treated by them. Dr. M. H. Cryer,⁵ who has made a very exhaustive study of this subject, believes that the great majority of antral inflammations are caused by intra-nasal conditions. He maintains that even if the prongs of a tooth which project into the floor of the antral cavity should become the seat of caries, nature always endeavors to protect the antra by a thickening, first

of the membrane, and then of the bone, covering these diseased prongs. For this reason pus formed at the root of a tooth is more apt to find its way into the oral cavity than it is into the antrum.

In this way references to the literature of this subject might be multiplied indefinitely, but such a procedure would be beyond the scope of this paper. In concluding this division of my subject I will only refer to a case which is a good deal of a curiosity. Dr. J. O. McReynolds^{1b} reports a case in which a patient carried a good-sized iron bolt in one of his maxillary antra for 4 years. There were no important unpleasant symptoms resulting from the presence of this foreign body.

CONCLUSIONS.

1. In my examination of 100 heads in the autopsy room, 37 per cent showed some evidence of pathological changes in the maxillary antra.

2. Of these 37 cases, 11 were examples of edema; 12 were examples of chronic inflammation or empyema; 1 was an example of an alveolar or dental cyst, and 13 were examples of retention cyst.

3. With one or two exceptions all of these cases were undiagnosed during life.

4. The presence of a large amount of pus in 10 out of 12 of these cases of empyema may have played an active part in causing the death of the patients.

5. In this series there was no particular disease with which inflammatory conditions of the antra were associated.

6. The cause of death in 21 of these 100 cases was tuberculosis, either of the respiratory, or intestinal tract. Nevertheless, there was only one example of a tubercular condition of the antral mucous membrane, namely in Case No. 22.

7. All of the cases of retention cyst were associated with a mild form of chronic atrophic catarrh, while several of the cases showed under the microscope a combination of a severe chronic inflammation and retention cyst.

8. The importance of antral inflammation as a factor in causing such diseases as inflammatory rheumatism, hay-fever, asthma and pneumonia is frequently overlooked.

9. The results of the foregoing examinations, combined with the reports of Harke and Fraenkel, should again call attention to the necessity for an early diagnosis of a chronic antral affection so that prompt remedial measures may be employed.

10. Anatomical research is universally corroborated by clinical experience in the selection of the intra-nasal route as the most satisfactory one for the performance of the great majority of operations on the maxillary antrum.

GHON METHOD OF SECTIONING SKULL.

Professor Ghon modified the method of Harke very considerably in order to simplify a systematic examination of the accessory sinuses. In the Harke method, after the free dissection of the soft tissues, a single *sagittal* saw-cut was made through the middle of the skull down to, and including, the foramen magnum. It was advised to make this saw-cut pass through the first two cervical vertebrae as well, in order to secure a free opening between the two halves of the skull divided in this way.

After a free dissection of the soft tissues as recommended by Harke, and shown in Figure 47, our method consisted in making an oblique and *transverse* saw-cut through the middle of the sphenoid, or sella tursica. This oblique saw-cut should be directed towards the lower part of the symphysis of the inferior maxilla. This cut opens up the sphenoidal sinus, the posterior nares and the roof of the mouth in every case. If the two antra are not simultaneously opened by this first cut a second oblique cut slightly further forward may be necessary. After the completion of this oblique section of the skull a final cut should be made through the middle of the frontal bone in a *sagittal* direction, and parallel with the nasal septum. When this last cut is made the facial portion of the skull is easily split open so as to expose the anterior nares perfectly. A small pair of scissors is sufficient for the division of any stray bands of mucous membrane which may interfere with a thorough view of these parts. The mucous membrane of the nasal septum is readily peeled off, as is shown in Figure 23. In this latter photograph the actual size and appearance of a head when opened by this method is shown. This photograph was taken from the occipital region forward, while the photographs shown in Figures 47 and 48 were taken from a side view.

In order to examine the ethmoidal sinuses it is only necessary to cut away the bony portion of the nasal septum with a pair of heavy cutting-forceps. The paper-like partitions of the ethmoidal laby-

rinth are easily broken down and these air spaces examined serially. It is no exaggeration to say that after making the dissection of the soft parts and the saw-cuts, as recommended, that all of the sinuses lie open before the observer like the pages of a book. In properly carrying out this method some little skill and practice is required, because if the dissection of the soft parts is not carried out with sufficient thoroughness the saw may penetrate tissues which it is very important to preserve intact. All of the 100 heads which I examined were given a subsequent decent burial, and no comment was made on anything unusual about the appearance of the corpse. I was never allowed to use, so-called anatomical material for my observations; therefore, great care had to be exercised in carrying out this method.

Experience taught me that if the first oblique saw-cut was carefully made it would invariably penetrate not only through the sphenoidal, but through both antral sinuses. In restoring the divided parts of the skull and the scalp to their proper places before the final sewing up of the tissues, no attempt was made to employ plaster of Paris for thoroughly sealing up the base of the skull. The use of such material or of double-pointed tacks I would suggest as valuable aids in securing perfect apposition of the parts.

The most usual site for post-mortem ecchymosis in those subjected to this method is in the neck in the neighborhood of the angle of the jaw. It is at this point, therefore, that the greatest care should be exercised in dissecting the soft parts from the underlying bone, as well as at the junction of the frontal with the nasal bones.

The application of this method is much simpler and its results much more satisfactory than either the Harke method or the method proposed by Dr. Obendorfer, of Munich, in April, 1909. At a meeting of pathologists held in Leipsic, on April 15, 1909, Dr. Obendorfer recommended making a *horizontal* section through the middle of both orbits completely through the skull in such a way as to leave nothing but the scalp and muscles of the occipital region to act as a hinge. We tried this method on Case No. 40 of my autopsy series with the result shown in Figure 34. The method proved to be both tedious and troublesome to carry out and unsatisfactory in its results. In skilled hands the Ghon method requires not more than 5 minutes for its completion, while this latter method required from 20 to 30 minutes. In this Obendorfer method the sphenoidal sinus and all of the ethmoidal sinuses are well opened,

but neither of the antra are opened at all, and the frontal sinus only imperfectly.

In the autopsy room of the Allgemeines Krankenhaus in Vienna, there were from 8 to 10 autopsies every morning. Through the courtesy of the professors in charge I was usually allowed to section from 2 to 3 heads a day by the Ghon method. It required 7 weeks to secure the pathological data herein recorded.

NOTE.

Among the friends and acquaintances of the writer, during the year 1909, four well-marked examples of chronic antral inflammation have occurred:

1. A physician about 36 years old told me that he had had frequent attacks of antral inflammation occurring at irregular intervals over a period of 4 or 5 years. He had never been operated upon for this condition, contenting himself with simple measures and allowing the disease to run its course. The diagnosis in this case was easily made by Ziem's system.

2. The wife of a friend in Vienna, about 28 years old, and of unusually robust appearance, had a right-sided chronic antral inflammation which lasted for several months. She was operated upon by the alveolar route and a tedious fistula resulted. At the end of a year the alveolar wound had not healed.

3. A girl, 6 years old, had double antral empyema which was overlooked for several weeks. She was operated upon by a skilled general surgeon to relieve a condition of sepsis and cellulitis of both sides of the face. The operation had been too long delayed and the child died 3 days later.

4. A physician about 45 years old had antral empyema in the summer of 1908. This condition improved under the care of specialists and without operation so that he had every reason to think that the antral trouble was cured. In the spring of 1909, general systemic poisoning, together with frontal sinus inflammation developed and he died a few months later.

MICROSCOPIC TECHNIC.

All of the sections made for the microscopic study of my cases were doubly stained with hematoxylin and eosin. The stain used for demonstrating the plasma cells or Unna stain is described on page 321 of Mallory and Wright's *Pathological Technic*.²⁰ I would also refer to the same authority for a detailed description of the Gram method and for the iron reaction employed in studying microscopic section from Case No. 13.

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Fig. 1.

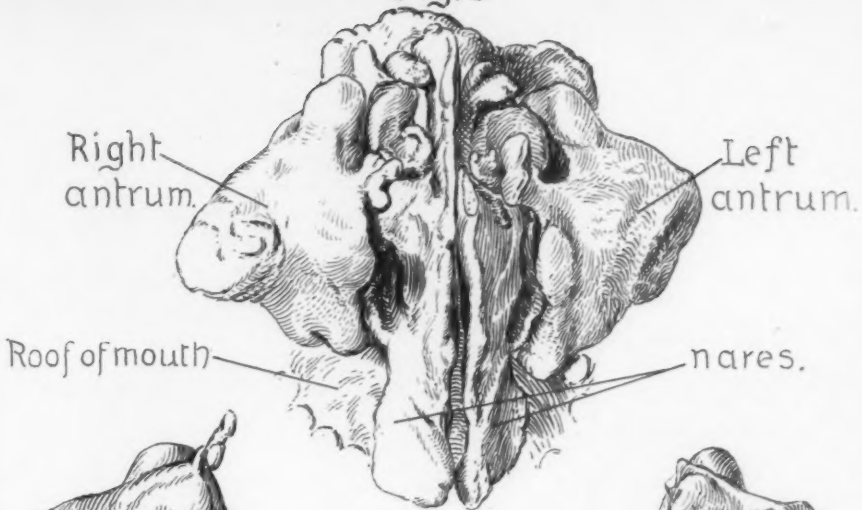


Fig. 2.
Anterior.



Ostia.

Fig. 3.
Lateral.

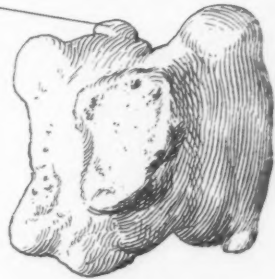
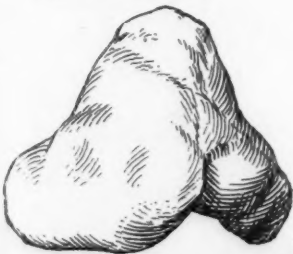


Fig. 4.
Posterior-inferior.



Wood's metal cast, actual size.



Figure 5. Diagram to show the position and direction of the three diameters marked A, B, and C, for determining the actual dimensions of the maxillary antrum. A, is the lateral measurement, B, the antero-posterior and C, the vertical. The first two measurements are taken approximately in the middle of the sinus, while the vertical measurement is taken where this diameter is the greatest.

The actual measurements of the casts shown in figures 1 to 4 were: R.: A. equals 26 mm.; B. equals 35 mm.; C. equals 38 mm. L.: A. equals 24 mm.; B. equals 27 mm.; C. equals 38 mm. (or 1½ inches).

Dr. Lack (12) gives the average diameters of the antrum as: A equals 25 mm.; B. equals 32 mm.; C. equals 35 mm.

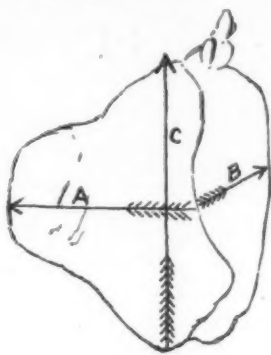


Figure 5.

MEASUREMENTS OF SEVEN CASES.

Case No. 25.—R.: A. equals 23 mm.; B. equals 55 mm.; C. equals 50 mm. L.: A. equals 22 mm.; B. equals 55 mm.; C. equals 40 mm. (See Figure 33).

Case No. 26.—R.: A. equals 20 mm.; C. equals 33 mm. L.: A. equals 18 mm.; C. equals 27 mm. (See Figure 35).

Case No. 12.—R.: A. equals 27.5 mm.; C. equals 45 mm. L.: A. equals 20.5 mm.; C. equals 47.5 mm.

Case No. 27.—L.: A. equals 20.5 mm.; B. equals 43 mm.; C. equals 40 mm.

Case No. 19.—L.: A. equals 25 mm.; B. equals 35 mm.; C. equals 50 mm.

Case No. 7.—R.: A. equals 25 mm.; B. equals 40 mm.; C. equals 40 mm.

Case No. 62 (autopsy series)—L.: A. equals 40 mm.; B. equals 40 mm.; C. equals 65 mm.

It is of interest to note the measurements of the antra secured from the first case in my autopsy series. This was a boy, five years old, who died of peritonitis following appendicitis. His antral measurements were: R.: A. equals 22 mm.; C. equals 24 mm. L.: A. equals 20 mm.; C. equals 23 mm.

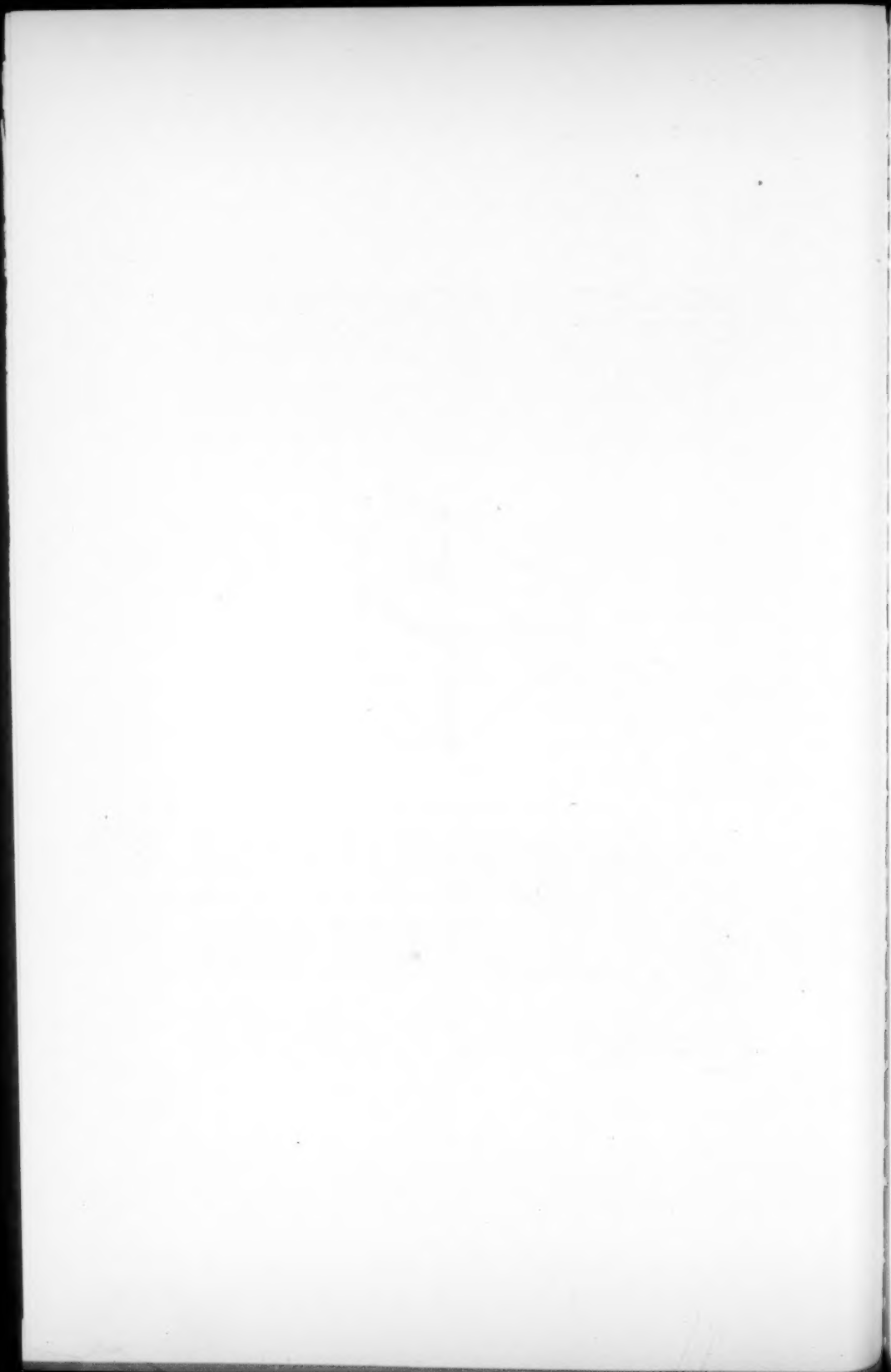


Figure 5. Diagram to show the position and direction of the three diameters marked A, B, and C, for determining the actual dimensions of the maxillary antrum. A is the lateral measurement, B, the antero-posterior and C, the vertical. The first two measurements are taken approximately in the middle of the sinus, while the vertical measurement is taken where this diameter is the greatest.

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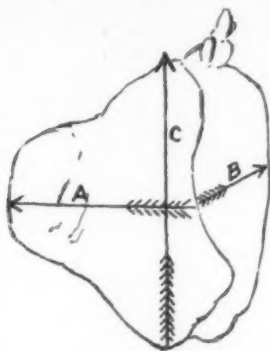


Figure 5.

MEASUREMENTS OF SEVEN CASES.

Case No. 25.—R.: A equals 23 mm.; B equals 55 mm.; C equals 50 mm. L.: A equals 22 mm.; B equals 55 mm.; C equals 40 mm. (See Figure 33).

Case No. 26.—R.: A. equals 20 mm.; C. equals 33 mm. L.: A. equals 18 mm.; C. equals 27 mm. (See Figure 35).

Case No. 12.—R.: A. equals 27.5 mm.; C. equals 45 mm. L.: A. equals 20.5 mm.; C. equals 47.5 mm.

Case No. 27.—L.: A. equals 20.5 mm.; B. equals 43 mm.; C. equals 40 mm.

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It is of interest to note the measurements of the antra secured from the first case in my autopsy series. This was a boy, five years old, who died of peritonitis following appendicitis. His antral measurements were: R.: A. equals 22 mm.; C. equals 24 mm. L.: A. equals 20 mm.; C. equals 23 mm.





Figure 6.

Figure 6. Posterior view of Section 1 of a formaline preparation made through the first molar teeth. This is a so-called frontal section. The transverse diameter of the right maxillary antrum in this case was 2½ cm. This preparation shows the average thickness of the alveolar floor when a section is made through that part of the face. This specimen was polished while still frozen in accordance with the method already detailed.



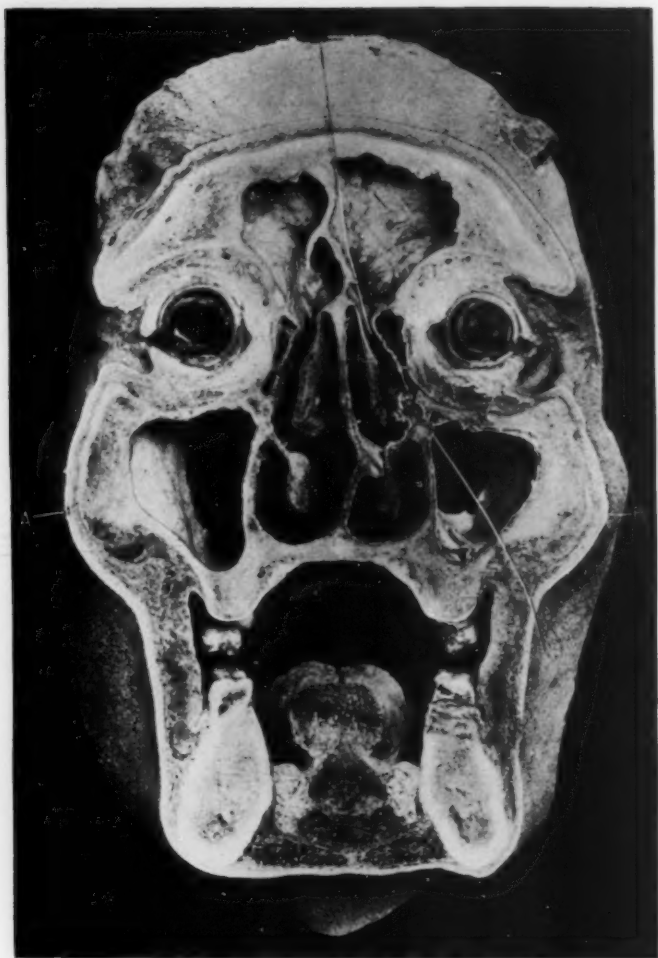


Figure 7.

Figure 7. Anterior view of Section 2 of the formaline preparation shown in Figure 6, these two surfaces having been in apposition to each other. These antra are somewhat larger than those of the average skull. A bristle passed readily from the left frontal sinus to the left antrum as shown in this photograph. The distance between the points marked A and B, or the most prominent parts of the cheeks, was $12\frac{1}{2}$ cm.

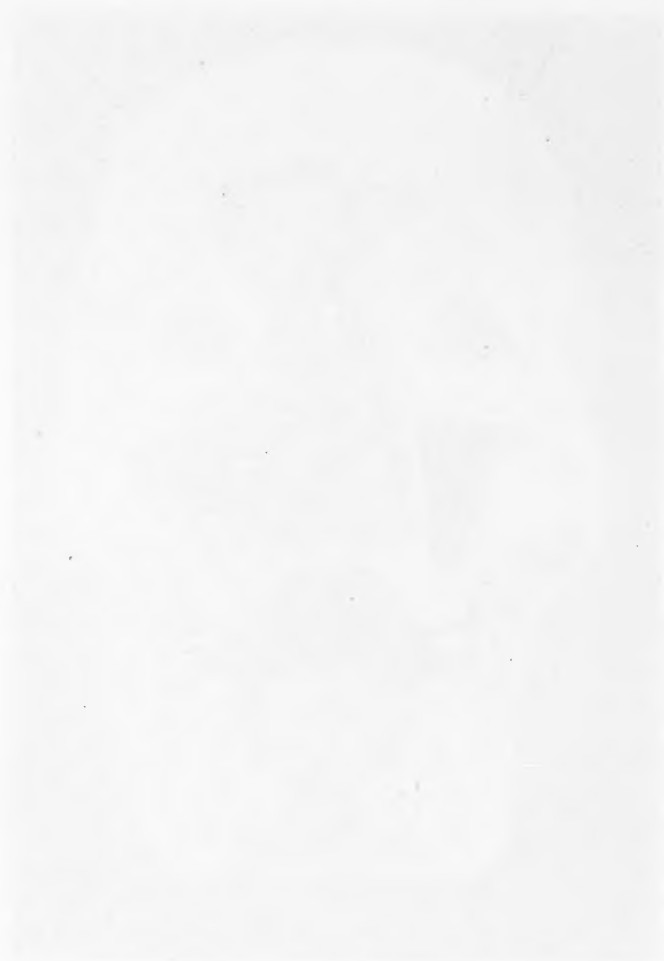




Figure 8.

Figure 8. Photograph of posterior view of section 2 of a formaline preparation. The bristle noted in Figure 7 can also be seen in this photograph. The direction and position of this bristle gives an exact idea of the site of the natural ostium in its relation to the antral cavity.



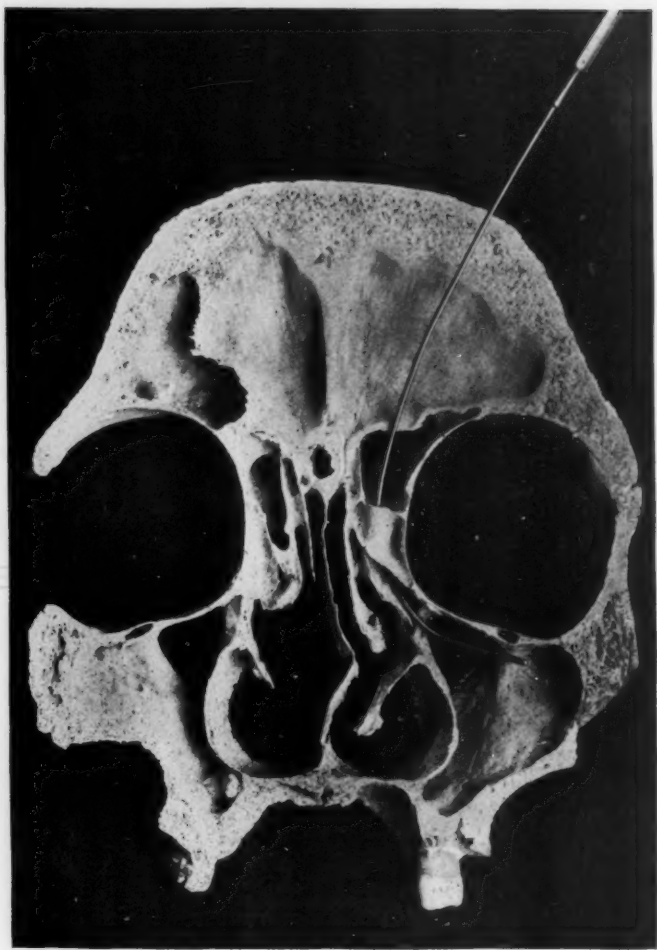


Figure 9.

Figure 9. Photograph of a bone preparation viewed from behind to show the intimate relation between the frontal sinus and the maxillary antrum. The probe passed readily through the infundibulum into a large natural ostium of the maxillary sinus. The extremely thin nasal wall bulging into the latter sinus is well shown.





Figure 10.

Figure 10. Anterior view of Section 3 of a formaline preparation. The saw has passed through the third molar tooth on both sides. Nothing remains of the antra but a portion of their posterior wall. It will be noted that in this position the antral floor is much thicker than it was through its middle.





Figure 11.

Figure 11. Photograph of the posterior view of a section through formaline head No. 2. The line of section passes through the first molar tooth on the left side. The prongs of this tooth project into the antral floor and are covered only by a very thin layer of bone and membrane. This section is made practically through the middle of both antra.





Figure 12.

Figure 12. Photograph of the anterior view of the next section of head No. 2, which would have come into apposition with the surface shown in Figure 11. The line of section again passes through the first molar tooth on the left side. The posterior walls of both antra are well shown.

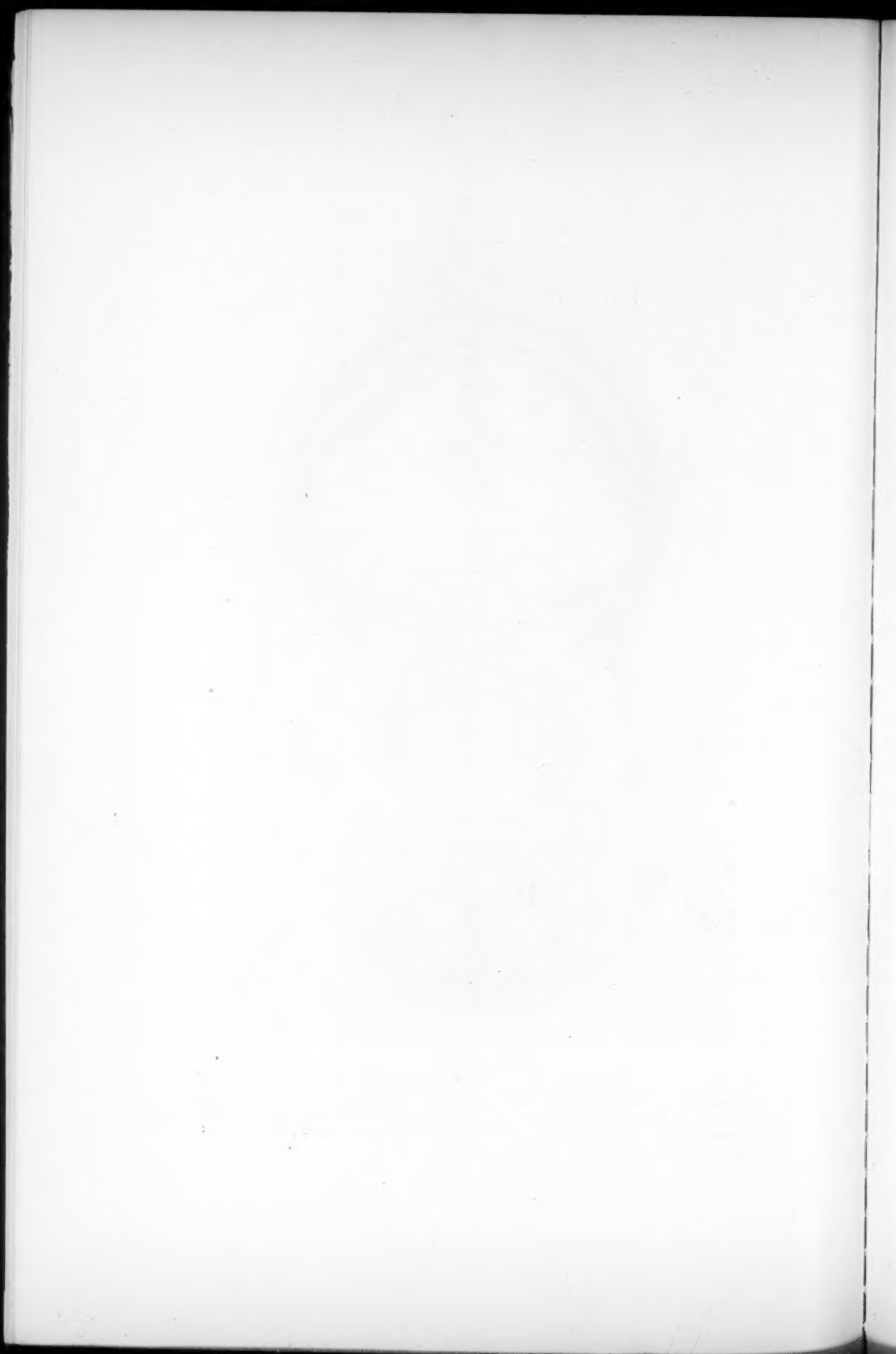




Figure 13.

Figure 13. Drawing of a very thin alveolar floor taken from the left antrum of Case No. 99 (actual size) showing the relation of the first molar tooth to the antral floor.



Figure 14.

Figure 14. Drawing of a very thick alveolar process (actual size) made from a dry preparation in my collection. Again this is the first molar tooth.

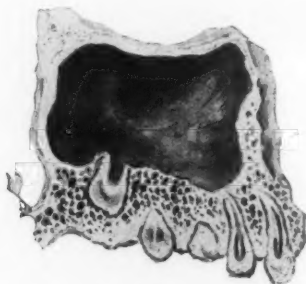


Figure 15.

Figure 15. Drawing of an unerupted first molar tooth causing inflammation in the floor of the right antrum. (After Cryer).





Figure 16.

Figure 16. Photograph of a wet preparation showing two large accessory antral openings. This is an unusual example of perforation of the uncinate process by the anterior of these two openings. Posteriorly, or behind this process, this accessory opening blends with the natural ostium.



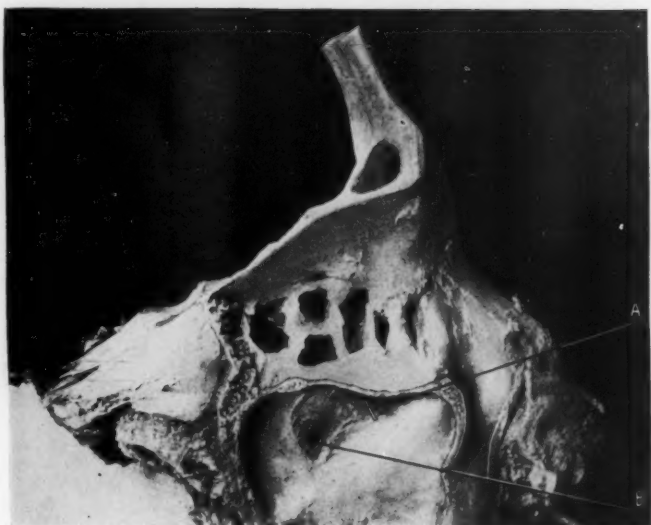


Figure 17.

A—Probe in natural ostium.

B—Accessory antral opening.

Figure 17. Photograph of a dissection to show the position of the natural antral opening or ostium as compared to an accessory opening. In this photograph the accessory opening is well shown while the natural opening is concealed by the shelf of bone which is all that remains of the roof of the antrum. The ethmoidal cells have been opened by cutting away the paper plate or inner wall of the orbit.



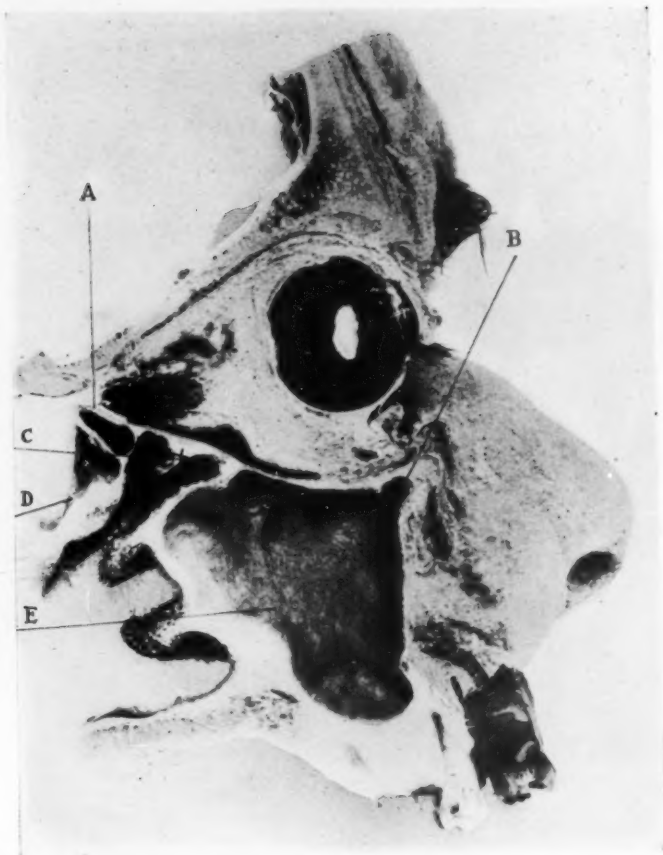
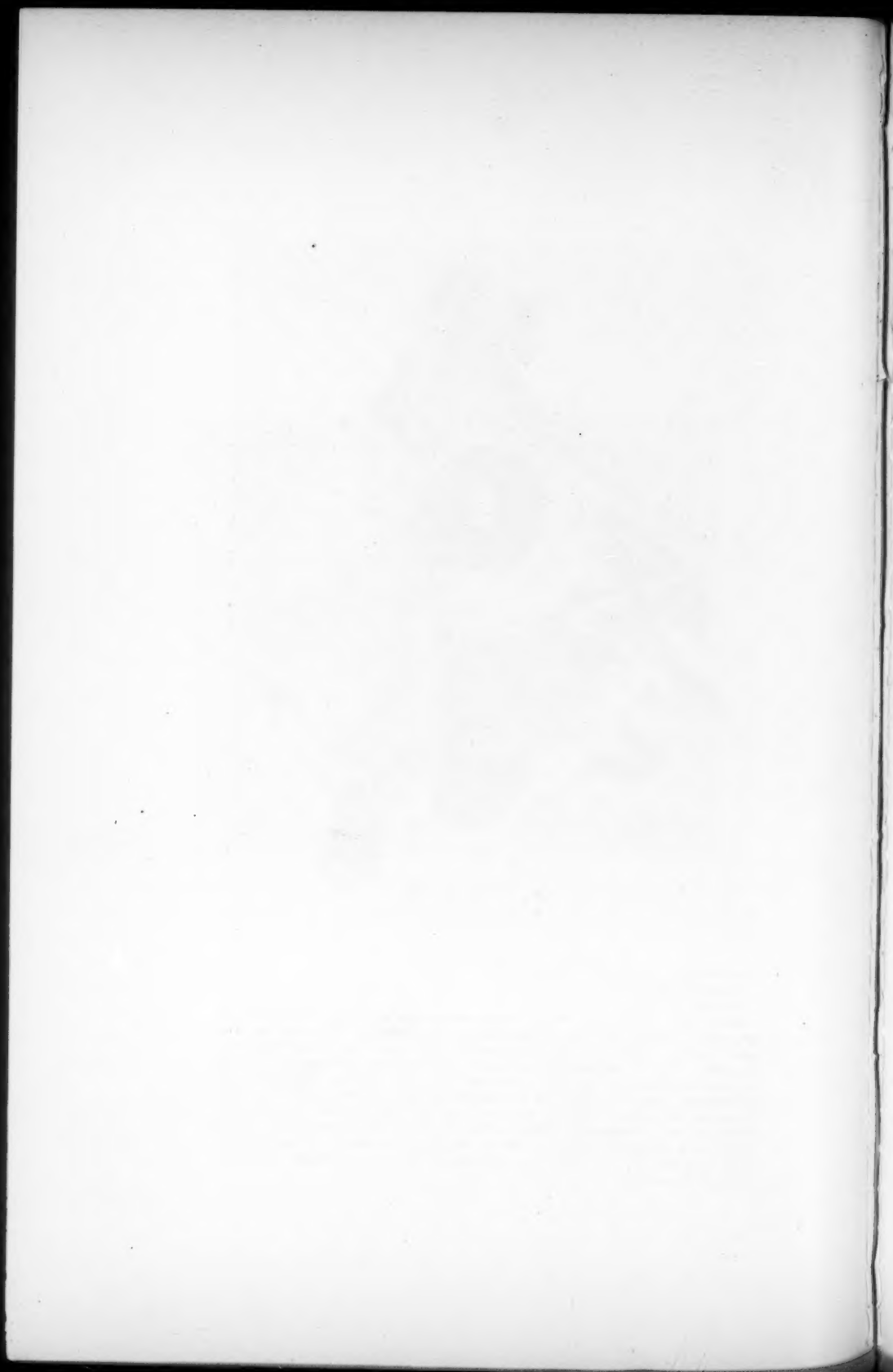


Figure 18.

- C—Superior turbinate.
- D—Sphenoidal sinus.
- E—Max. antrum.

Figure 18. Photograph of an oblique section of an adult white skull to show the extreme thinness of the roof of the antrum. This section was made in such a way as to pass through the optic nerve at its entrance into the orbit. Before the section was made a hypodermic syringe of India ink was injected into the orbit through the optic nerve. This India ink distributed itself, not only in the posterior part of the orbit, but also along the periphery in such a way as to outline that cavity. This is well shown in the photograph. The divided tooth in the foreground of the picture is a second bicuspid. Between the points A and B, the actual distance was $4\frac{1}{2}$ cm., so that this enlargement is slightly bigger than the actual preparation.



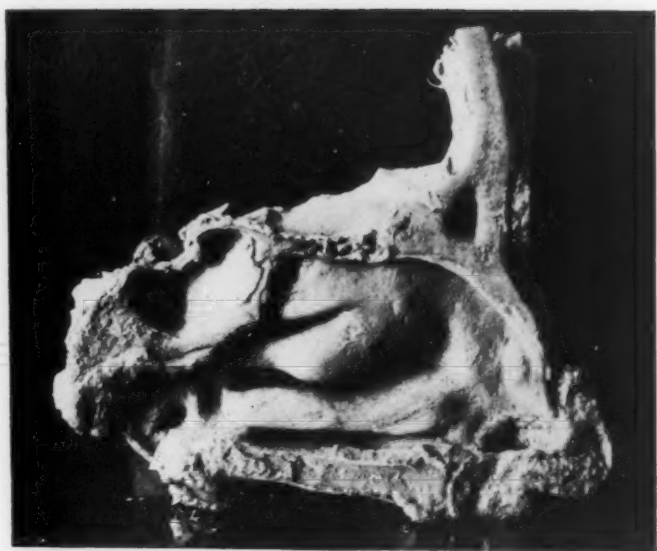


Figure 19.

Figure 19. Photograph of the nasal side of the nasal wall of a maxillary antrum, of the left side, with the turbinates in position. The turbinates are considerably shrunken from having been in a 5% formaline solution for many weeks.



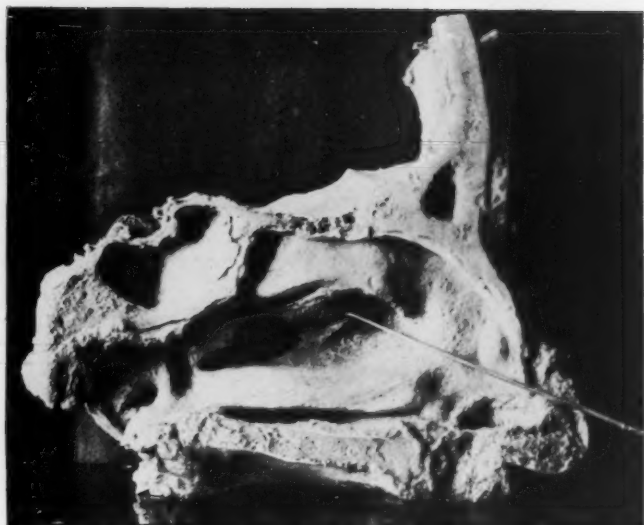


Figure 20.

Figure 20. Protograph of this same wet preparation shown in the preceding figure after removal of the middle turbinate in order to demonstrate the infundibulum and hiatus semilunaris. It will be seen that the infundibulum is bounded in front by the processus uncinatus, and posteriorly by the bulla ethmoidalis. A probe has been introduced through the nares into the natural antral ostium. The distance between the notches on this probe is 2 cm.





Figure 21.

Figure 21. Photograph of a transverse section of a full grown sheep's nose 10 cm. from the anterior nasal spine. While the maxillary antra are present in this specimen they are almost completely divided into two cavities by the upward projection of enormous teeth.

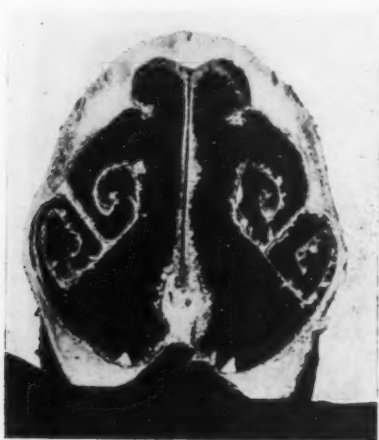


Figure 22.

Figure 22. Photograph of an obliquely directed transverse section of a white bearded gnu (*Comochaetes Taurinus Albojubatus* from British East Africa). In taking this picture the camera was also obliquely directed to the specimen so as to get the greatest amount of penetration. The greatest diameter of this section is 7.7 cm., while the nasal septum measures from above downward 6.5 cm. There is the same double scroll-like formation of the turbinates in this case as is seen in the sheep's nose, but there are no antra present.





Figure 23.

A—Mucous membrane of nasal septum.

B—Ext. aud. meatus.

Figure 23. Photograph of a case of typical antral edema on the right side from Case No. 1. The mucous membrane is greatly thickened. This head was opened by the Harke-Ghon method.



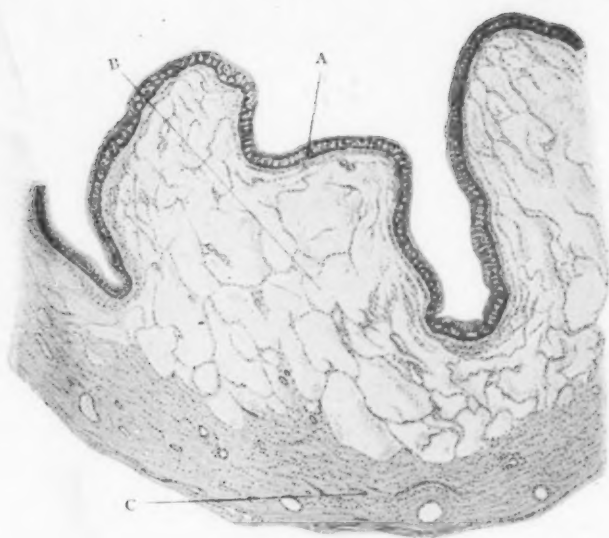


Figure 24.

Figure 24. Section of mucous membrane from Case No. 6, showing typical appearance of edema under the microscope. Magnified 40 times. The stratified epithelium is shown at (A); the loose edema at (B), and the connective tissue at (C).

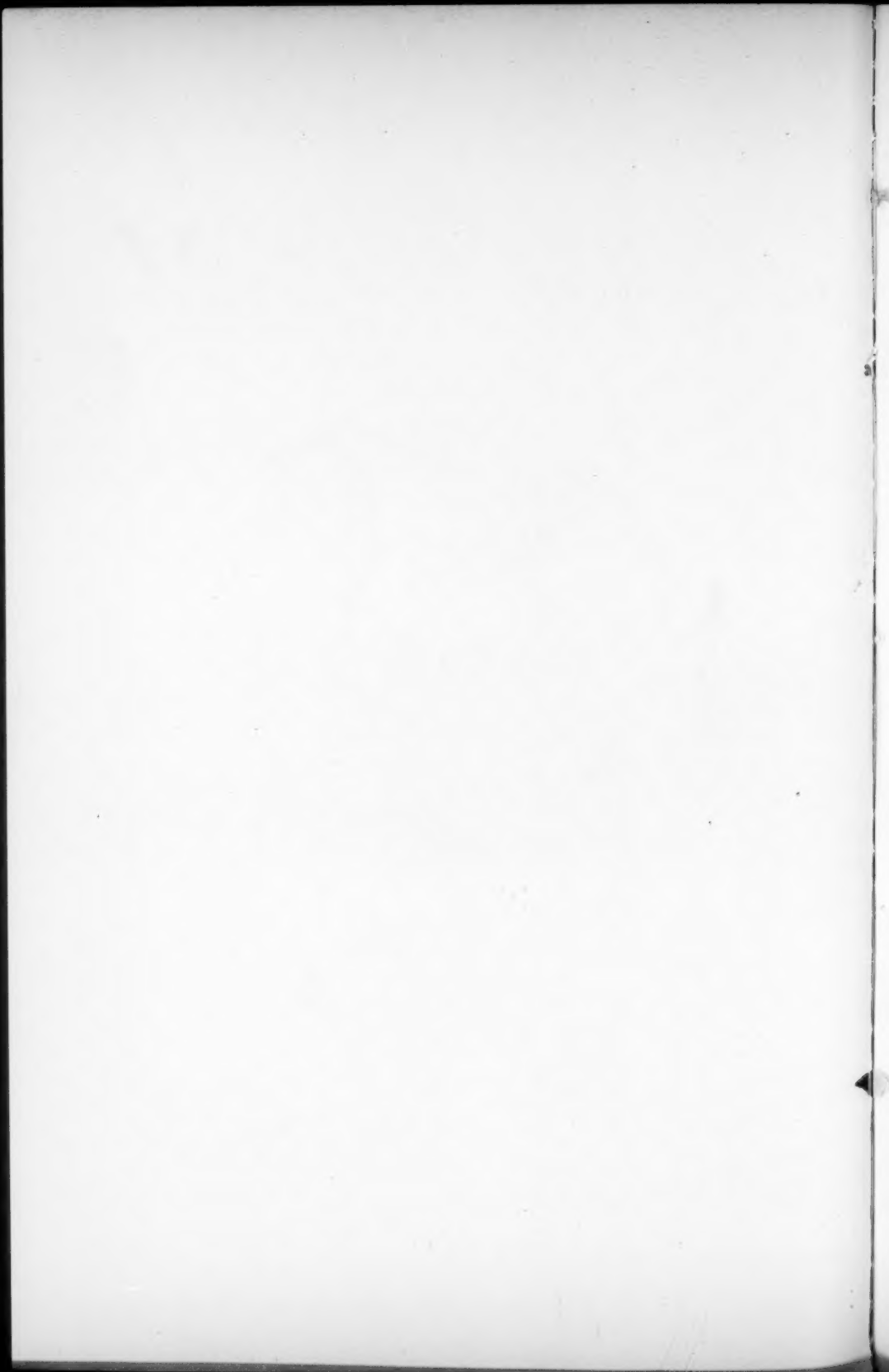
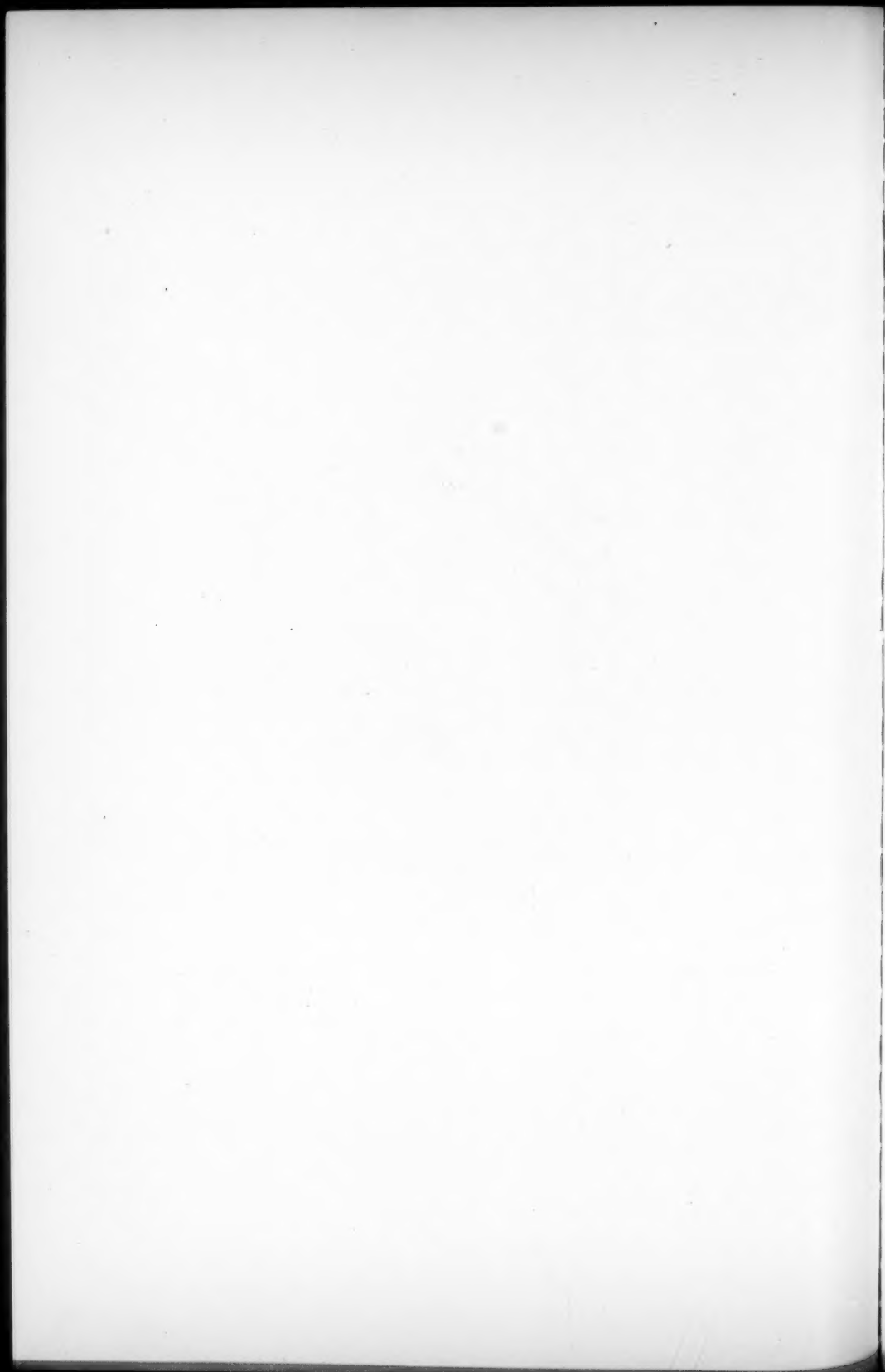




Figure 25.

Figure 25 Cystic dilatation of a gland filled with colloid-like material in a case of chronic inflammation (Case No. 13). It shows a reduction in the number of strata and a flattening of the lining epithelium at (a). Note the infiltration of the tissue about the cyst with mono-nuclear cells (lymphocytes and plasma cells). Magnified 160 times.



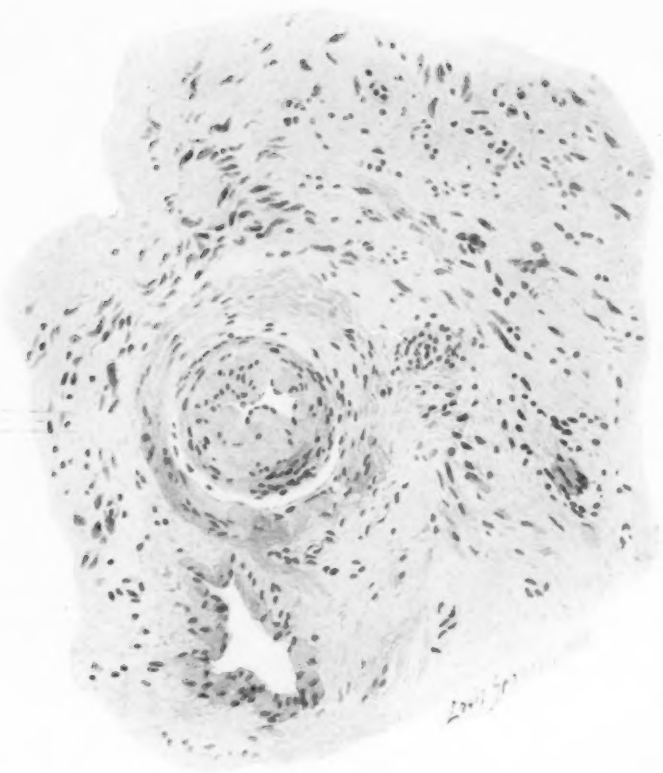


Figure 26.

Figure 26. Section of a portion of the mucous membrane in Case No. 13 showing, near the center, a sclerosed and nearly occluded arteriole. The surrounding connective tissue is likewise sclerosed, presents numerous fibro-blasts, mono-nuclear leucocytes and plasma cells, together with phagocytes laden with light brown hemic pigment. Magnified 80 times.

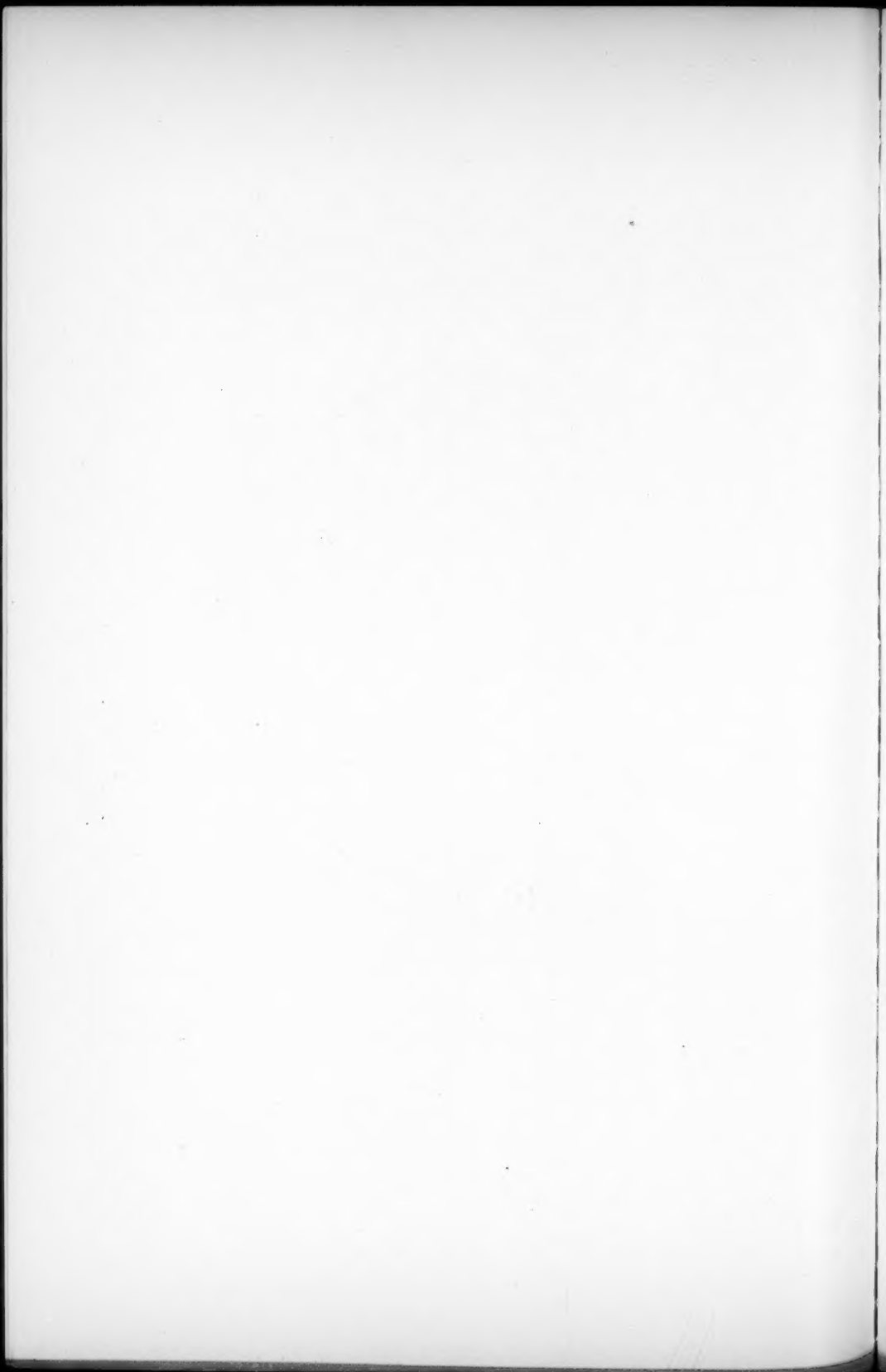
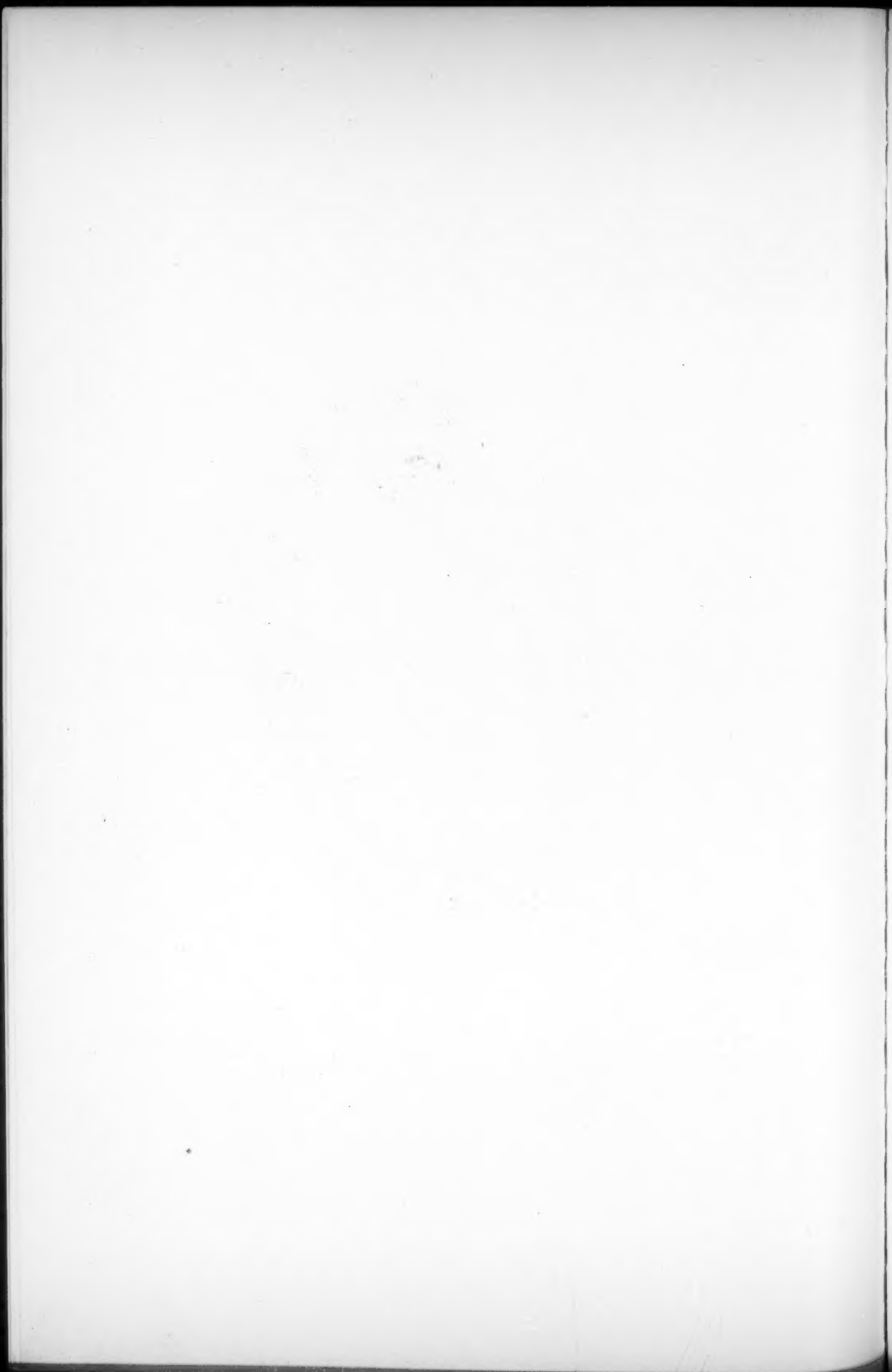




Figure 27.

Figure 27. Section of a portion of the mucous membrane from Case No. 16, showing a large flask-shaped dilatation of a mucous gland filled with colloid-like material. The surrounding connective tissue is somewhat sclerosed, and the seat of marked infiltration of lymphocytes, plasma cells and a few phagocytes. This was a case of chronic empyema. Magnified 160 times.



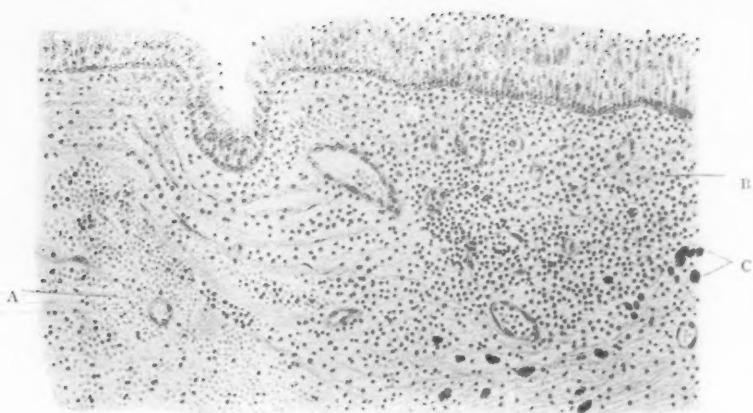
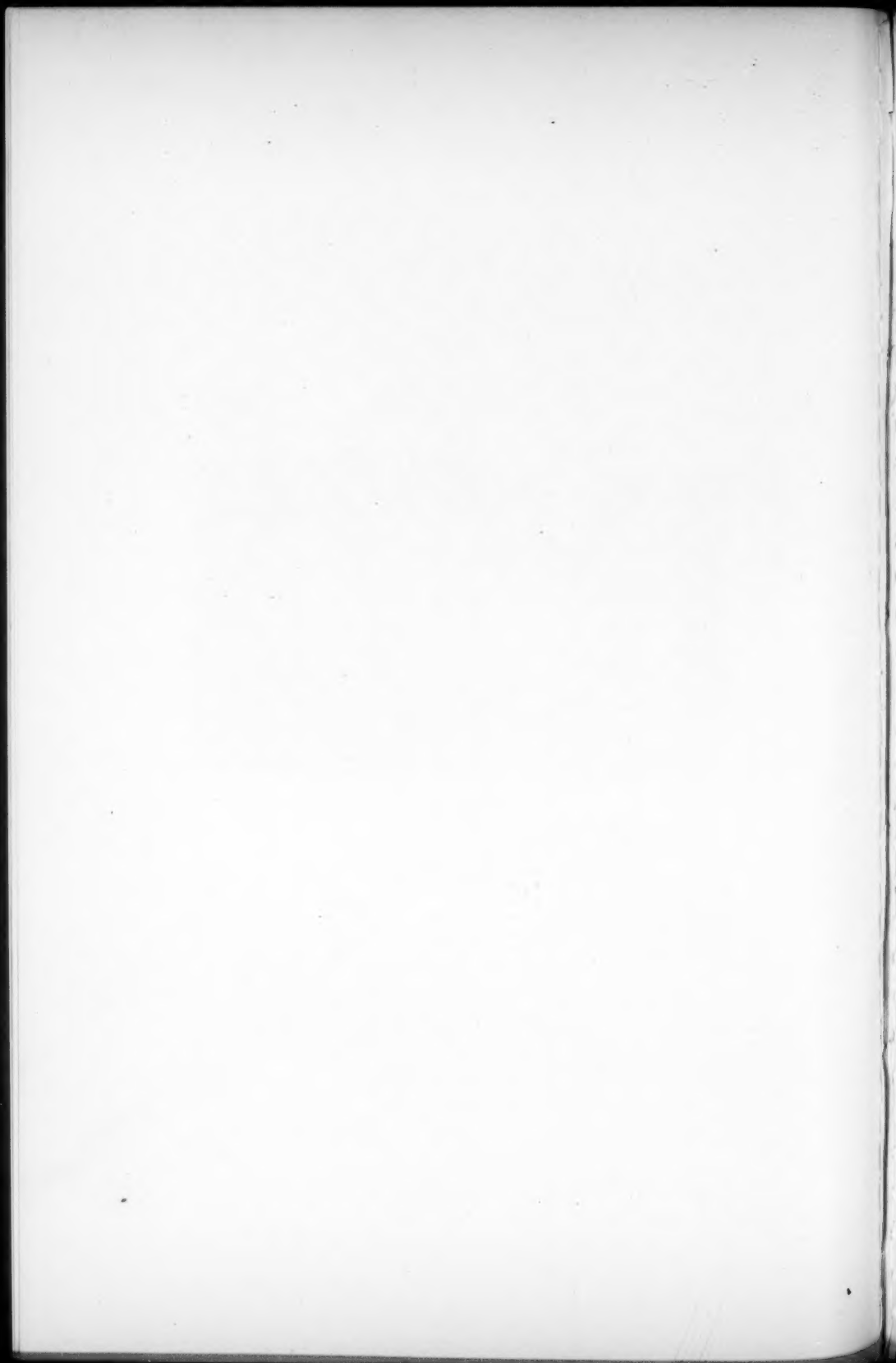


Figure 28.

- A—Hemorrhage.
- B—Inflammatory infiltration.
- C—Pigment.

Figure 28. Section of the mucous membrane from Case No. 19, which was an example of empyema. It is magnified 120 times. The ciliated stratified columnar epithelium is well shown with a slight cup-shaped depression in one place. Below this layer there is a well-marked inflammatory infiltration, considerable haemic pigment and evidence of recent hemorrhage.



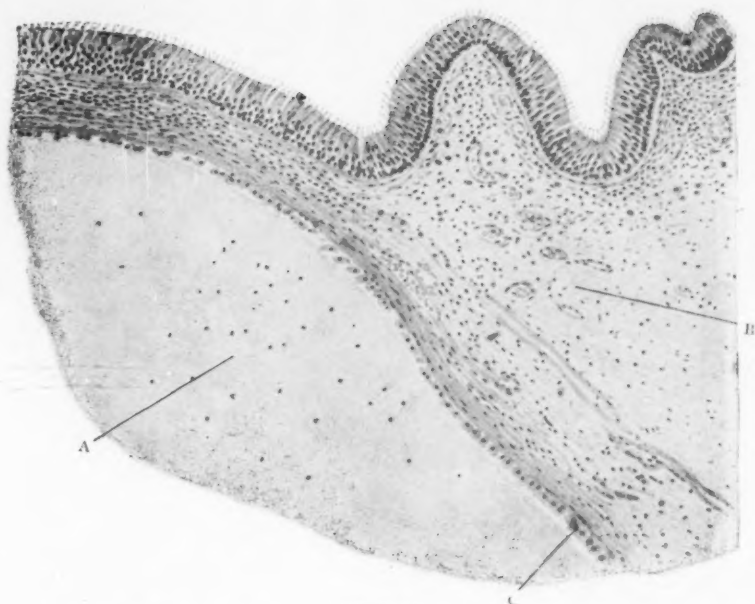
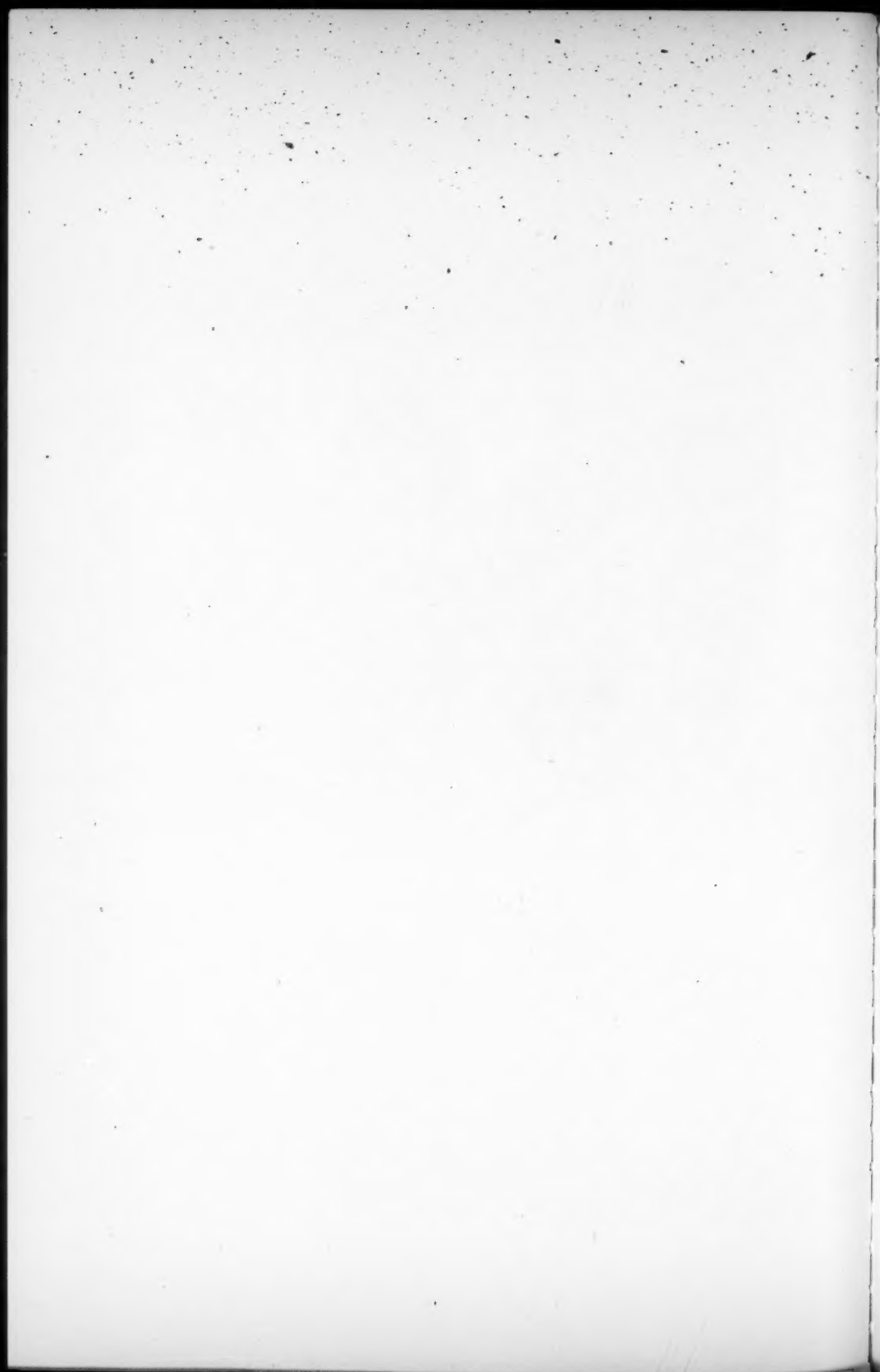


Figure 29.

- A—Colloid-like contents.
- B—Connective tissue.
- C—Degenerated epithelium of cyst.

Figure 29. Section of mucous membrane from Case No. 12, an example of chronic inflammation accompanied by cyst formation. The surface of the stratified ciliated columnar epithelium is thrown into folds. Below this there is a considerable amount of connective tissue present. Beneath the single layer of degenerated epithelium lining the cyst and its colloid-like contents.



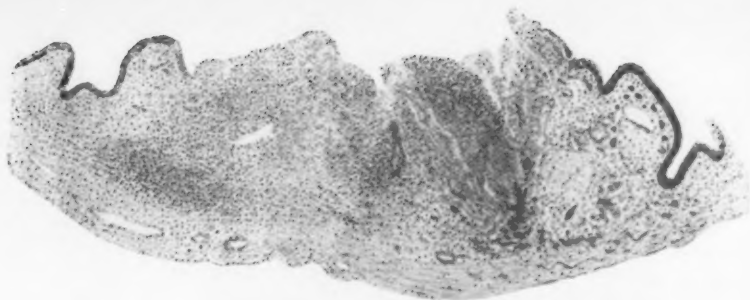


Figure 30.

Figure 30. Section of the mucous membrane from Case No. 20, an example of empyema. This section is magnified 20 times. It shows ulceration of the mucous membrane with a necrotic base surrounded by hemorrhage.

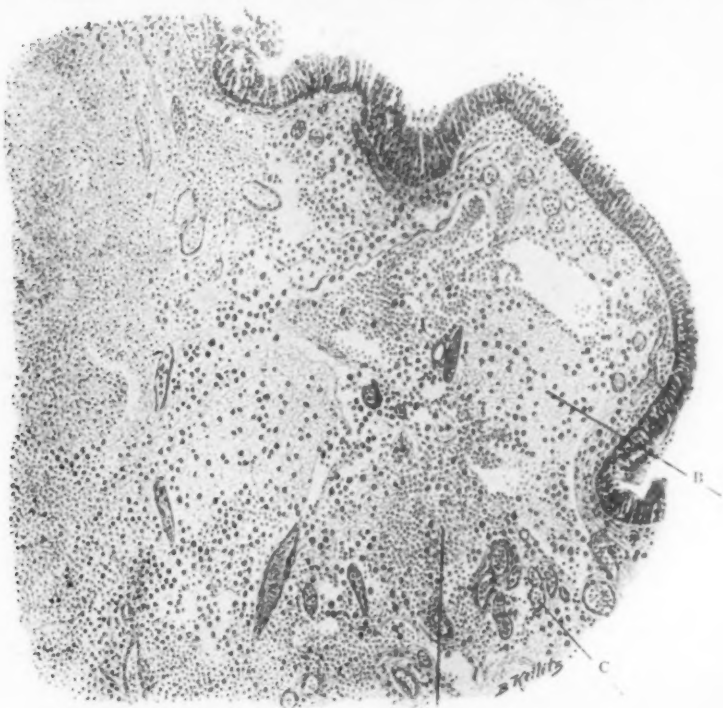


Figure 31.

- A—Pus corpuscles.
- B—Blood corpuscles.
- C—Young capillaries.

Figure 31. Upper right hand corner of the necrotic ulcer represented above. Magnified 80 times. This shows hemorrhage, pus corpuscles and newly-formed capillaries. The Gram stain showed the mucous membrane to be rich in staphylococci, many of which are in the phagocytes.



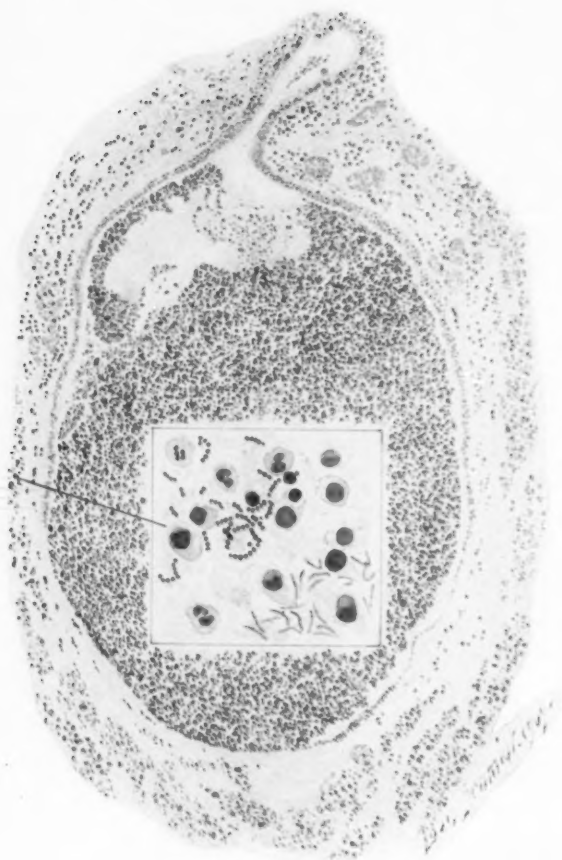


Figure 32.

Figure 32. Purulent dilatation of a duct of a mucous gland from Case No. 21. This mucous membrane was taken from the right antrum, the seat of an empyema. The dilatation is filled with pus and the lining epithelium is destroyed in places. The surrounding tissue is full of infected capillaries, is edematous and infiltrated with poly-nuclear leucocytes. Magnified 45 times. The square in the center shows higher power drawing (magnified 800 times) of a field situated in the periphery as indicated by a line. This shows the tissue stained by Gram's method invaded by chains of streptococci and a more faintly staining undetermined bacillus. The eosin stained plasma cells are well shown.



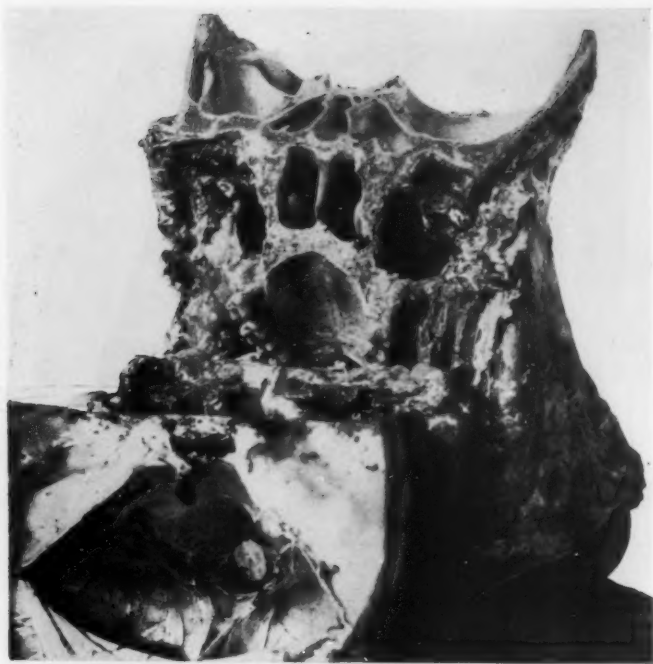


Figure 33.

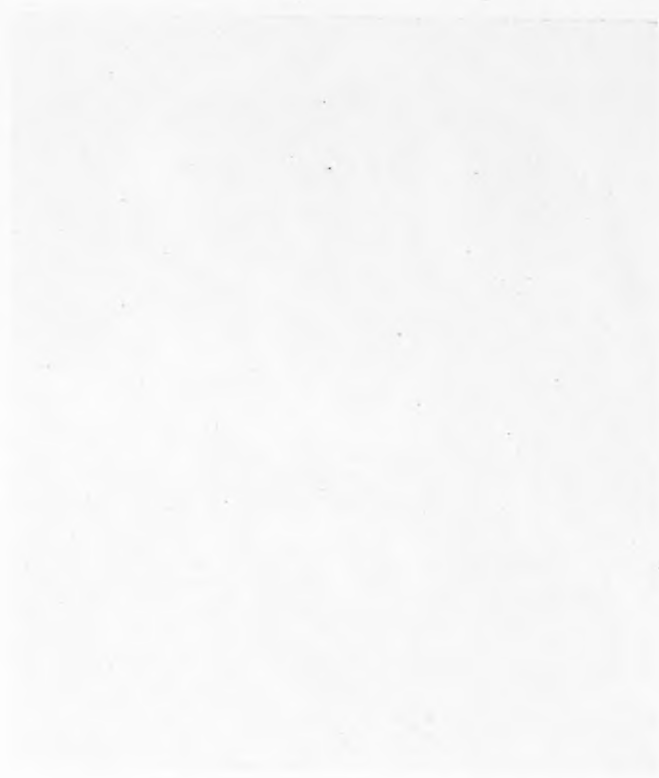
Figure 33. Photograph of Case No. 25 to show the appearance of a skull opened by the Harke-Ghon method. The first oblique saw-cut made here was followed by another somewhat similar cut because the antra had not been thoroughly opened. The final sagittal cut through the frontal bone had not been made. This latter cut is illustrated in Figure 38.





Figure 34.

Figure 34. Photograph to show the appearance of a head when opened by the method recently recommended by Dr. Obendorfer. By this method a horizontal cut is made at the junction of the nasal bones with the frontal directly through the ethmoidal sinuses and the sphenoidal sinus back to the foramen magnum. This photograph was made from Case No. 40 of my series. The results are not as satisfactory as they are by the method herein described and the technique is much more tedious.



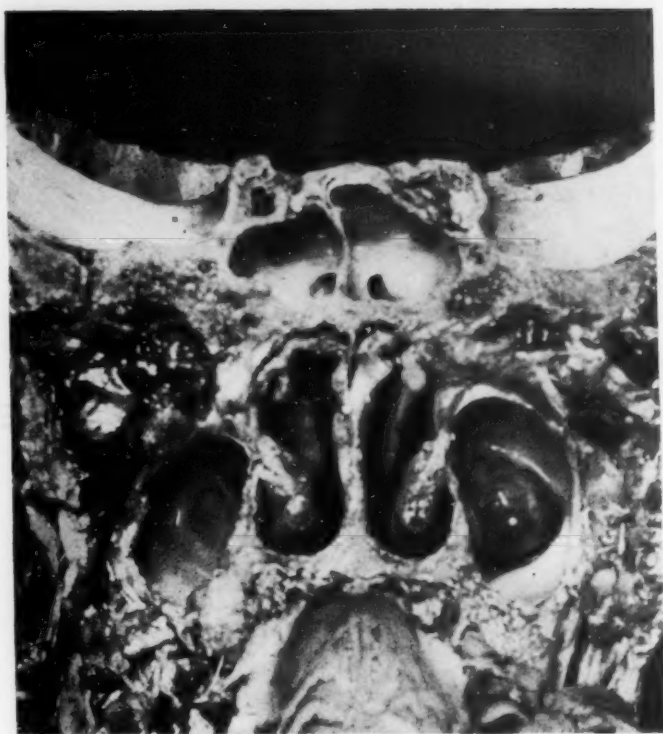


Figure 35.

Figure 35. Photograph of Case No. 26, showing the actual size of a multilocular cyst of the right maxillary antrum as seen from behind. This photograph was taken immediately after the skull was opened by the Harke-Ghon method.



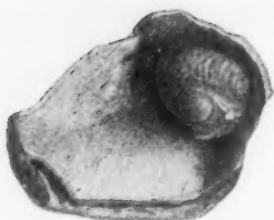


Figure 26.

Figure 26. Drawing of the specimen from Case No. 26 as seen after removal. It was attached at the junction of the anterior part of the nasal wall with the roof of the antrum. The inferior turbinate is also shown.

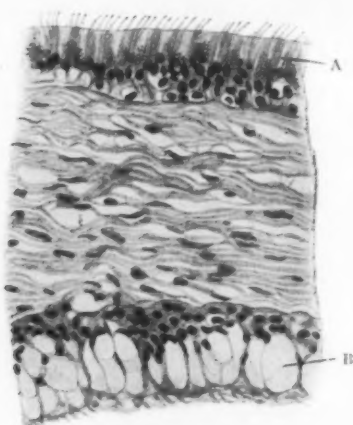


Figure 37.

Figure 37. Section of the wall of the cyst from Case No. 26 showing (A) stratified ciliated columnar epithelium; (B) goblet cells. Magnified 300 times.



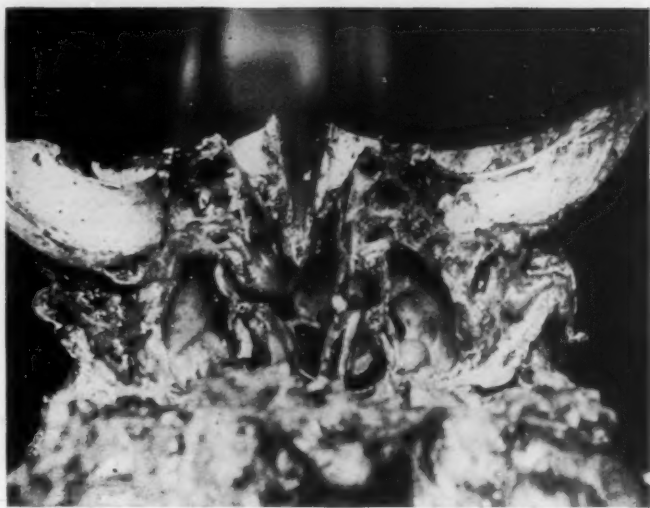


Figure 38.

Figure 38. Photograph of a large retention cyst in the floor of the right maxillary antrum of Case No. 39. The actual size of this specimen is shown in Figure 41.

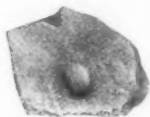


Figure 39.

Figure 39. Drawing of the actual size and appearance of a small retention cyst from the middle of the nasal wall of the left antrum in Case No. 27.





Figure 40.

Figure 40. Drawing to show the actual size and appearance of two similar cysts from the roof of the right antrum in Case No. 31.

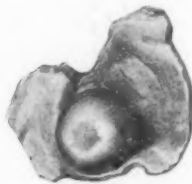


Figure 41.

Figure 41. Drawing to show actual size and appearance of the cyst shown in Figure 38.



Figure 42.

Figure 42. Drawing of the right antral floor from Case No. 33, to show the area of erosion caused by the presence of a multilocular cyst. The area of erosion is indicated at (A).



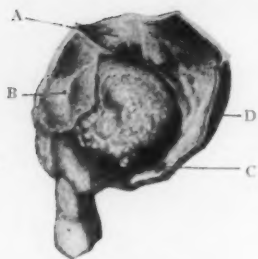


Figure 43.

A—Max. antrum.
 B—Canine fossa.
 C—Alveolar process.
 D—Oral mucous membrane.

Figure 43. Drawing actual size of the alveolar cyst noted in Case No. 24. This view is taken from before backward. The tooth is the second bicuspid of the right side.

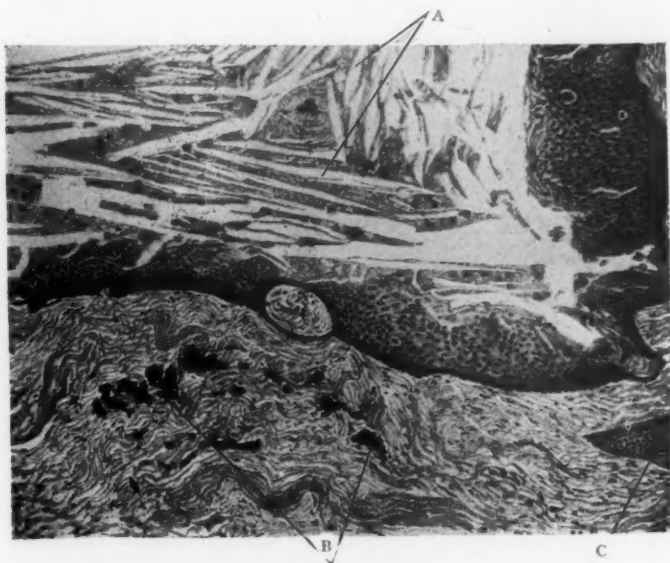


Figure 44.

Figure 44. Microscopic appearance of a section through the alveolar or dental cyst depicted above. Magnified 120 times. The contents of this cyst are of a cheesy character, showing numerous clefts occupied by cholesterolin (A); there is some hemic pigment (B); and epithelial islands or projections as noted at (C).



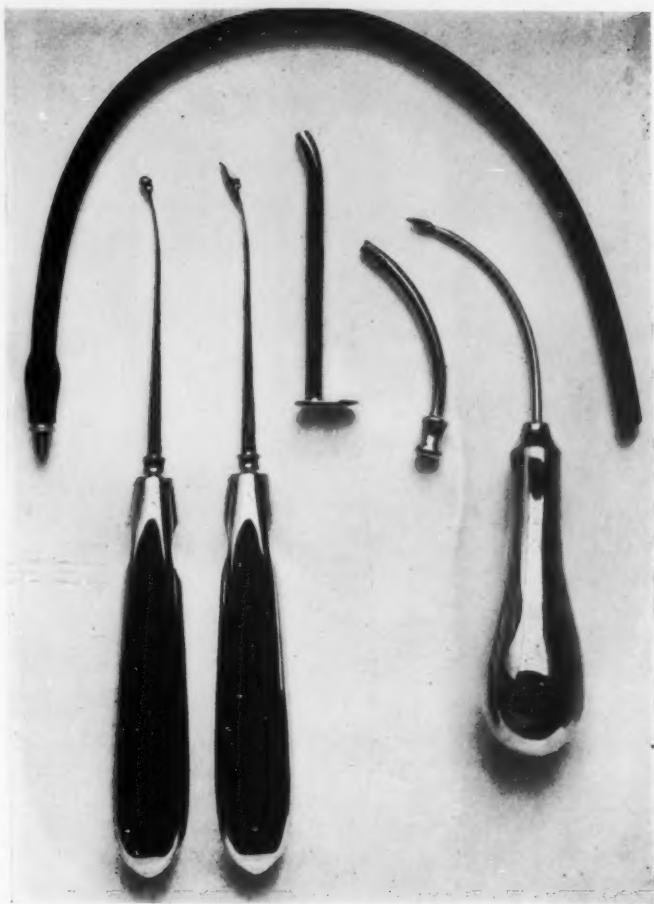


Figure 46.

Figure 46. Photograph of the instruments required for puncture of the antrum. Either the decidedly curved trocar and cannula or the straighter and longer one may be used. If the latter is employed, the obturator shown in the center of the photograph may be employed for the reintroduction of this instrument. The rubber tube curving over the top of these instruments may be inserted in either cannula and used for flushing out the antrum.





Figure 47.

Figure 47. Photograph to show the extensive dissection of the soft tissues necessary to carry out the Harke-Ghon method and the line of the first saw-cut.



Figure 48.

Figure 48. Photograph to show the appearance of a head after the completion of the Harke-Ghon method. It will be seen that in this case it was only necessary to make one oblique cut through the body and greater wings of the sphenoid obliquely directed towards the point of the chin. This oblique cut was followed by a sagittal cut through the frontal and ethmoid bones down to the junction of the nasal bones with the frontal.



A CASE OF APPARENTLY PRIMARY INTRA-LARYNGEAL ACTINOMYCOSIS.*

BY H. ARROWSMITH, M. D., BROOKLYN, N. Y.

James Homer Wright, in Osler's "Modern Medicine," describes actinomycosis as "a suppurative process, combined with growth of connective tissue and characterized by the presence in the lesions, of vegetations or colonies of a specific micro-organism—the actinomyces bovis. The specific infectious agent exists in the lesions and in the pus in the form of small whitish or yellowish irregular-shaped granules, in diameter from a fraction of a mm. to 1 or 2 mm. They may be soft and easily crushed, or hard resistant and even calcareous. The essential element of the granules is a branching filamentous micro-organism and certain transformation and degeneration products thereof. Over more or less of the periphery of the granules are closely set, hyaline, refringent club-shaped bodies of varying size and thickness, arranged in a radiate manner, while elsewhere, the periphery is occupied by filaments of the micro-organism, likewise set closely together and disposed in a radiate manner.

The specific micro-organism of actinomycosis probably exists normally among the abundant flora of the secretions of the alimentary tract. It may gain entrance to the tissue through wounds, made by penetrating foreign bodies, or otherwise, or through lesions due to carious teeth, or it may invade the lungs, as do other bacteria of the mouth and pharynx. In the tissues it develops into the characteristic colonies or granules and by further proliferation gives rise to the disease. The disease in and about the jaws is frequently associated with carious teeth. Hitherto it has been assumed that this organism is widely distributed in the outer world on grains and vegetable material and is by them introduced into the body. Actinomycosis is not contagious, probably, but is most common in individuals living under unfavorable hygienic conditions. It is claimed that more cases are found among persons living in cities and in the male sex. Actinomycosis has long been known in cattle, chiefly as a form of sarcoma of the jaw. According to Erving, one hundred cases in man had been observed in America up to

*Read before the Laryngological Section, New York Academy of Medicine, November 24, 1909.

December, 1902. (*Bulletin Johns Hopkins Hospital*, Vol. 13, p. 261, 1902).

The essential effects produced in the tissues by the actinomycetes are suppuration and tissue destruction, combined with new formation of granulation and connective tissue, which in some instances may be excessive and simulate a neoplasm. The irritative action of the parasite may affect a wide area. Extension may take place by continuity of the lesions and by metastases, the latter occurring by way of the blood-vessels. Abscess and sinus formation is frequently observed. It may happen that the starting point of an extensive process may be difficult or impossible to find.

Four forms may be differentiated, according to the point of origin or principal location of the lesion. Actinomycosis of the head and neck, constituting about one-half the cases in man, practically all originating about the buccal and pharyngeal cavities—thoracic actinomycosis occurs in about 15 per cent of the cases, abdominal in about 20 per cent, while cutaneous lesions are rare.

The symptoms vary with the severity and extent of the process and the tissues and organs involved. The course of the disease may be acute with much fever and pain,—or chronic with little or no fever or pain. Any of the types may develop one from the other. In chronic cases, cachexia may be present. Locally the evidences may be those of acute inflammation, with abscess and sinus formation, or there may be swellings without inflammatory symptoms, simulating neoplasms.

Diagnosis is made possible only by the discovery of the micro-organism in the pus or tissues, or, in actinomycosis of the respiratory passages, possibly in the sputum.

The prognosis depends on the extent and localization of the lesions:—Some cases recover spontaneously but recurrences are not infrequent. The treatment consists in the administration of potassium iodide, in general hygienic management and in surgery, as indicated. (J. H. Wright).

The special feature which is of interest to us, is the involvement of the respiratory passages in this process and particularly disease of the larynx itself. Practically all the recorded cases are what Henrici calls actinomycosis laryngis externa. (*Fraenkel's Archiv.*, Vol. 14). He quotes Illich (*Beitrag zur klinik der Actin.*, 1892) as contending that "laryngeal actinomycosis" should be applied to only those cases in which the infection originates within the larynx, or where actual actinomycotic intra-laryngeal lesions exist, which

have extended thither from other starting points. Henrici further says that in no case then on record as "laryngeal actinomycosis" had actual invasion of its structures been demonstrated. There had never been more than an implication of the soft parts of the neck in the immediate vicinity of the larynx, to which it had reacted by exhibiting a collateral edema. He also mentions as the one convincing report, a case of Ponfick. (*Festschrift zum 25 jähr. Jubiläum von Rud. Virchow*) in which, as incidental to a generalized actinomycosis, he described partial calcification of the laryngeal cartilages, the mucous membrane being reddened and swollen, with a large number of irregular flat ulcerations, which were most numerous on the vocal cords and in the sub-glottic space and deepest at the posterior part of the vocal bands.

Heinrichs (*Fraenkel's Archiv*, Vol. 16) describes a case which is also extra-laryngeal. Hoffmann (*Münch. med. Wchnschr.*, No. 10, March, 1906), in a most comprehensive review of the whole subject of actinomycosis in general, relates the history of his case, which, on autopsy, showed numerous sinuses in the trachea which communicated with adjacent abscesses, although there seemed to be no definitely characteristic lesions within the trachea or larynx. He describes the condition as "actinomycotic thyroid perichondritis, with collateral edema of the larynx."

In *Semon's Cntrlbl.* for March, 1910, A. Natzler (Dissert, Leipzig, 1908), records a case in which laryngeal obstruction necessitated a tracheotomy, the wound healing slowly and leaving a secreting fistula, from the pus of which actinomyces were recovered. Later there appeared a gradually increasing swelling of the side of the neck. The infection seemed to have started in the left tonsil. Iodide of potash was of no avail, but the ultimate outcome is not stated. The reference says that Natzler speaks of 15 cases in the literature but a detailed enumeration is not given.

Jonathan Wright (*Am. Journ. Med. Sci.*, Vol. 128) describes in detail a case of actinomycosis of the tonsil and, in his analysis of the general subject, hints at a possible relationship between the actinomyces and the tubercle bacillus, quoting Metschnikoff, who declared that the tubercle bacillus was not the final stage, but represented a condition in the developing cycle of a thread-like bacterium,—and Fischl, who called attention to the resemblance of the tubercle bacillus, in certain forms, to the actinomyces.

As far as I have found in literature, in one case only, that of Ponfick, has the larynx been intrinsically the seat of actual actinomy-

cotic lesions. Therefore the patient whose history I now present, is of particular interest, showing as it does some peculiarities not mentioned in any of the clinical histories I have been able to find. This patient has already been before the Section earlier in the year, with the presumptive clinical diagnosis of laryngo-scleroma, which was unsubstantiated by microscopical examination, because I desired to leave the larynx in statu quo, until it had been seen by the members of the Section.



Figure 1. Shows low power drawing of field containing many actinomycetes clumps associated with blood, pus cells, coagulated fibrin and shreds of connective tissue-stained haematox—eosin x50.

I. B., male, 19 years old, presented himself at my clinic in September, 1909. He is a native of Cracow and had been in this country 3½ years,—a shoe-stainer by occupation. At home he had lived on a farm and had worked among horses and cattle. His family history was entirely negative as was also his previous personal history. Two months before admission, he noticed a slight hoarseness, which gradually increased until he could speak only in a whisper,—it was for this symptom alone that he sought relief. There was at times, a slight “stinging” in the throat which had never been more than disagreeable. For two weeks previous to admission, there

had been a slight cough and some dyspnea on exertion. His only antecedent nose and throat symptoms had been an occasional trifling epistaxis from the right nostril.

Examination of the thorax negative; the sputum was negative and the urine showed no deviation from the normal; temperature normal; weight, 119 lbs.; general appearance good. The nose, pharynx and tonsils were absolutely normal and the teeth in excellent condition and well cared for. The epiglottis was slightly thickened and to the right of the median line, on the laryngeal surface there was a small, whitish deposit. In the region of both



Figure 2. Shows high power drawing of field containing the three actinomyces clumps at x in Figure 1, showing the fringed edges and the homogeneous center of lime salts. Stained haematoxylin-eosin x500.

true cords and completely covering and concealing them, were irregular masses of dirty white tissue, more than half-occluding the chink of the glottis. The same sort of tissue lined the trachea as far down as one could see, which was but a short distance, by reason of the encroachment on its lumen by this adventitious material. He was given vigorous anti-syphilitic treatment for a month, without improvement. Then scleroma suggested itself to my mind and he was presented here with a tentative diagnosis to that effect. The laryngeal conditions had appreciably improved under the ad-

ministration of thiosinamine, given empirically for its reputed power to disintegrate new-formed tissue. (Allyl sulphocarbonide).

In December, several portions of the laryngeal mass were removed and sections sent to Dr. Jonathan Wright, who reported as follows, in January: "After a more careful examination of the slides you sent me I am confirmed in the opinion that the appearances, especially of the section labelled first specimen, allow no other diagnosis than that of actinomycosis. The epithelial hyperplasia and the marked swelling of the epitheloid cells, or lymphocytes, is due to the tissue disturbance set up by the parasite. There is also marked nuclear fragmentation, considerable hyaline degeneration and destruction of the connective tissue fibrils. In a specimen so small as this and so much disorganized by the process and

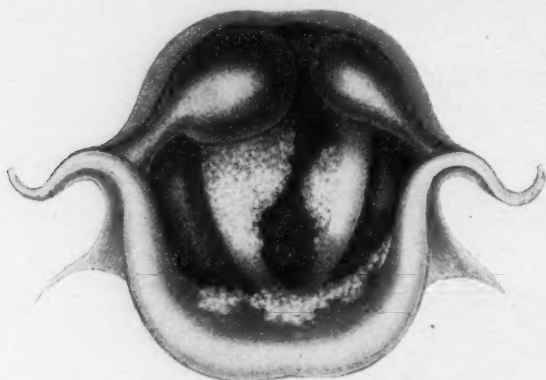


Figure 3. Condition of Larynx, April 6, 1910. Case of I. B.

by the operative interference, the topographical features are not of value in the diagnosis, but the clumps of actinomyces bodies in the first specimen are in my opinion, pathognomonic."

The patient was put on increasing doses of potassium iodide without apparent improvement. On January 29, Dr. B. F. Cline, of the Brooklyn Eye and Ear Hospital, reported "I was unable to find any evidence of actinomycosis in the sputum received from you to-day. There were present occasional tubercle bacilli, streptococci and groups of staphylococci."

March 24, Dr. Cline reports again: "Sputum shows numerous tubercle bacilli, staphylococci and streptococci. No evidence of actinomycosis can be found."

Physical signs of consolidation were now discoverable in the right upper lobe. There was some cough, emaciation, irregularity of temperature, anorexia and digestive derangement. At his last visit, April 6, while the laryngeal condition remains about as it was, the patient's general state is deteriorating. At the last examination, there was an area in the vault of the pharynx which presented an appearance identical with that in the larynx,—previously there had been absolutely no lesion discoverable, elsewhere than within the larynx (this was conceded by several members of the section who examined him and by Dr. Wright, who saw him after his report). In this case the classic avenues of infection from the pharynx, teeth or tonsils can apparently be thrown out. There has been no involvement of the soft tissues of the neck, none of the commonly reported thickened bands showing the route of the infection, the sputum has been free from the organism, there has been no suppuration or abscess formation, nor have any of the characteristic granules been found.

It is, of course, impossible to say with absolute certainty, that there may not have been some antecedent actinomycotic pulmonary involvement, but it was not discovered on careful examination until some time after the tubercle bacilli were found in the sputum, and the physical signs then present, were the classic ones of early pulmonary tuberculosis.

In the light of Wright's quotations from Metschnikoff and Fischl, the development of tubercular lesions are certainly interesting though they may be merely coincidental.

Shortly after his last visit the patient sailed for Europe and his subsequent history is unknown.

170 Clinton Street.

HEMILARYNGECTOMY FOR EPITHELIOMA; EXHIBITION OF THE PATIENT.*

BY T. PASSMORE BERENS, M. D., NEW YORK.

Mr. X., aged 49, presented himself for examination on April 26, 1909, with the following history: For the past 4 or 5 years has had hoarseness that troubled him particularly when singing. The hoarseness increased and began to trouble him when talking. Two years ago he consulted an eminent laryngologist, who informed him that he had a small growth on one of his vocal cords and advised its removal. Mr. X. referred the matter to his family physician, who persuaded him not to have the operation or further treatment of his throat.

His singing teacher about this time told him that his voice (basso) was misplaced, and taught him to sing tenor. This replacing of the voice was successful, so far as his singing voice was concerned, for during the following year and a half he sang to his own satisfaction, although his speaking voice frequently was hoarse. For the few months previous to his first visit to me his hoarseness increased, until his speaking voice was permanently affected, although the singing voice at times was clear, especially for the higher tones. His personal and family history was negative for syphilis, tuberculosis and cancer.

Examination: The patient is a tall, large, well-proportioned man of about 230 lbs., presenting a picture of robust health. There has been no loss of weight. No cachexia was present. The glands in the neck could not be palpated. Laryngeal examination revealed a growth resting on the left vocal cord, occupying its anterior two-thirds, and spreading over its free edge into the chink of the glottis. On phonation this overhanging portion of the growth moved upward. It did not perceptibly interfere with the movements of the cord and allowed the production of a clear tone. The color of the growth was grayish with a slightly pink hue. It was apparently sessile with a surface suggestive of papilloma. Its size was that of a white bean. There was no induration noticeable in any other part of the larynx.

On April 29, under the influence of cocaine and adrenalin, the cord was readily freed of the growth by intra-laryngeal operation

*Read before the American Laryngological, Rhinological and Otological Society, Washington, D. C., April 28, 1910.

with the Schroetter tube-forceps. The growth was removed in several large masses with very little discomfort to the patient. The bleeding was slight. In cutting the growth a peculiar sensation as that of cutting through a crisp apple was felt. After removal it was apparent that the growth had been attached to the upper surface of the cord throughout almost the anterior two-thirds. The tumor was sent to the laboratory of the Manhattan Eye, Ear and Throat Hospital for examination, and Dr. Jonathan Wright reported as follows: "This specimen presents the characteristic structural features of flat-celled epithelioma. There are stickle cells, epithelial whorls and infiltration of the stroma with atypical cells which spring evidently from the superficial layers of the epithelium of the cord."

The diagnosis was explained to the patient, and he readily consented to an external operation, even after its gravity had been fully dwelt upon. A consultation was advised, and the following is an extract from a letter received from Dr. Delavan, upon whom the patient called: "I have examined your patient, Mr. X., with all possible care. It seems very difficult to estimate just how far below the left vocal band the growth may extend. From the appearance of the band itself it does not seem necessary to pronounce the case as undoubtedly malignant. The microscopical findings, however, would seem to set this matter at rest and establish the diagnosis beyond a doubt. The apparent chronicity of the case would, of course, be in its favor.

"In the light of the histological diagnosis it would seem to me that while such cases have in former years been treated by intralaryngeal methods with occasional success, with our present knowledge such a course would not be justified. Considering the history of the growth, and also fully appreciating the unusually favorable conditions in general which are present in this case,—such as moderate age, a strong constitution, a fairly well regulated life, the absence of bronchitis and weakness of the heart, and other possibly complicating factors,—and in view of the slow progress which the disease has seemed to make, it would appear that surgical intervention would offer unusual possibilities of help. The apparent absence of glandular involvement is another favorable omen. It would seem therefore that the least that could be done would be to divide the larynx and then determine to what extent removal of the diseased area should be affected.

"Mr. Butlin has lately made some changes in his views, assuming the position taken by Dr. John Mackenzie to the effect that the

lymph nodes should be removed in all these cases. This is such a radical change on his part that it seems worth mentioning. I do not go so far as to advise it in this particular case, but simply call your attention to this somewhat remarkable fact. I have told Mr. X. that the best hope of success lay in operation, supposing meanwhile that the microscopical findings have been correct."

On May 10, in the Manhattan Eye, Ear and Throat Hospital, the following operation was performed under ether anesthesia, which had been preceded by a hypodermic injection of morphine and atropine: An incision was made in the median line of the neck from the *Os Hyoid* downward almost to the sternal notch. The thyroid isthmus was pushed downward and the first and second rings of the trachea were incised, care having been taken not to carry the incision through the mucous membrane of the trachea. Adrenalin 1-1000 solution was then applied to this exposed mucous membrane and it was incised without bleeding resulting. Two per cent cocaine in 1-1000 adrenalin solution was then sprayed into the larynx through the tracheal opening, and the cricoid and thyroid were split in the median line. The adrenalin controlled the bleeding completely. Examination of the larynx showed the left cord to be much thicker than the right, and palpation revealed thickening of the false cord and of the greater part of the central portion of the mucous-membrane covering the left half of the larynx. Owing to this extensive thickening of the mucosa the left half of the larynx and of the cricoid were removed. The epiglottis was well above the indurated area and was not disturbed. The cervical glands were not enlarged and were not removed. The wound was stitched in layers with heavy gut, a tracheotomy tube was inserted, and the patient returned to bed. The recovery from the anesthesia was without nausea and the shock from the operation was slight. Convalescence was unexpectedly rapid, the patient visiting me in my office 2 weeks after the operation. This rapidity of convalescence was undoubtedly due to the magnificent courage and keen good sense of the patient. He taught himself to swallow liquids on the third day by hanging his head over the edge of the bed, and *swallowing upwards*.

The report by Dr. Jonathan Wright of the result of the examination of the tissues removed was that all of the epithelioma had been removed at the time of the intra-laryngeal examination. Examination will reveal in the region of the left arytenoid a small nipple, the result of a fold in the mucous membrane during the stitching of the wound. Other than this, the left side of the larynx is occu-

pied by a smooth cicatrix, against which the right cord vibrates, with the production of a useful speaking voice which is fairly strong, being distinctly audible over the telephone.

There are several points of interest in this case apart from the all-important fact of his apparently complete recovery: The difficulty in arriving at a correct diagnosis in spite of the man's age; the long duration of the condition; the surface appearance and color of the growth; the mobility of the cord; the apparent lack of induration of the nearby tissues; the absence of palpable lymphatics in the neck and the general good health of the patient; the unexpected finding, during the second operation, of thickened tissue in the false cord and ventricle that could not be seen, at least was not observed by the laryngoscope, and indeed at the time of operation was more palpable than visible,—this thickened tissue later proving to be but simple inflammation, the result probably of bruising during the intralaryngeal operation; the rapid and uneventful convalescence; lack of bleeding into the trachea, from the free use of adrenalin; and the fair volume of voice that has resulted.

35 Park Avenue.

Nasal Diphtheria. D. Roy, *Jour. A. M. A.*, Aug. 6, 1910.

Roy says that many rhinologists no doubt often have looked into the nasal cavities and have found adhesions between some portions of the turbinates and septum and have asked immediately whether there has not been an operation previously on that side. Many such cases no doubt are due to operations in the nose, especially ill-advised and ill-executed galvanocautery applications, but some of them are due also to this condition of chronic diphtheria or membranous rhinitis, for in one of his cases, in spite of the very best attention, an adhesion did form between the lower turbinate and septum on one side which later had to be cut. We must recognize the multiform manifestations of diphtheria wherever there is a mucous membrane; and whenever a child continues to have a cold in the head with excoriations at the muco-cutaneous surface and occasional nose-bleed, we must look on this condition with suspicion.—*N. Y. Med. Jour.*

UNUSUAL FOREIGN BODY IN RIGHT BRONCHUS REMOVED BY LOWER BRONCHOSCOPY.*

BY CHARLES W. RICHARDSON, M. D., WASHINGTON, D. C.

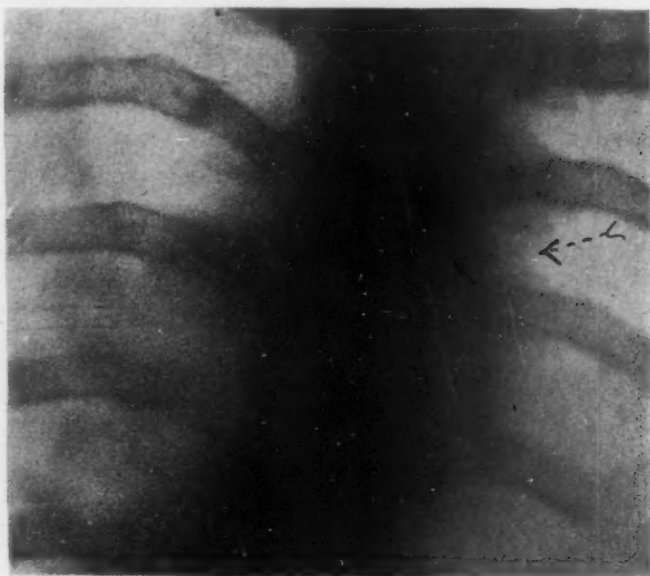
On January 3, 1910, shortly after 10 A. M., I was notified by Dr. Frischkorn that a patient of his, a young woman, had inspired a piece of a large rubber ink eraser, which he conjectured was then located in the right bronchus. The doctor further stated that he would have patient removed at once to the Garfield Hospital where a radiograph would be made by Dr. Merrill, and then to the Episcopal Eye, Ear and Throat Hospital for operative removal of the foreign body. The patient was brought to the hospital in the late afternoon. The picture displayed a large foreign body lodged in the right bronchus protruding slightly into the trachea. The patient was in a fair condition. There was no cyanosis, and cough



was entirely absent. All the auxiliary muscles of respiration were in active co-operation. Her only complaint was of soreness and tired feeling about the neck and upper part of the chest. Respiratory sounds were exaggerated over the left side of the chest; respiratory sounds were absent over the whole of the lower portion of the right lung. The patient's temperature was normal. At 1 P. M., all preparation having been completed, an attempt was made to remove the foreign body by upper bronchoscopy. Chloroform narcosis was induced by Dr. Dye, and Dr. McKimmie supported the head in the Jackson position. The Killian tube was readily passed through the larynx and down to the foreign body. The body was observed as a grayish-white object, but as the illumination was so imperfect and as the efforts at removal under such condition seemed obviously so impracticable, I

*Read before the Annual Meeting of the American Laryngological, Rhinological and Otological Society, Washington, D. C., April 29, 1910.

decided to do a tracheotomy and resort to lower bronchoscopy. Through the tracheal opening I introduced a Jackson tube, by means of which I readily recognized the foreign body. Numerous efforts were made to remove the body by all the forms of grasping forceps at my command; all attempts being attended with a like degree of failure. None of the forceps possessed sufficient width of grasp to encompass the broad end of the presenting foreign body. Every effort was attended with the removal of small pieces of the rubber from which the eraser was made. Recognizing the futility



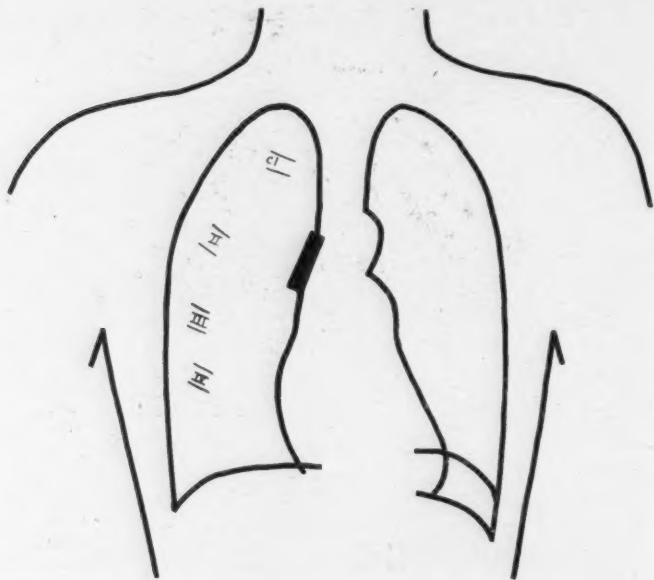
of further efforts with the instruments at hand, and as the patient was evidently in distress, I decided to desist until I could procure the proper instrument to effect the object which I desired to accomplish.

It seemed to me, since the body was firmly fixed, as was evident through the efforts at removal, it would be possible to engage its presenting end in the mouth of the tube and, thus firmly held, screw into the eraser the instrument which I proposed having made, and extract the body.

I imparted my idea of the necessary methods of attack to Dr. McKimmie. I instructed my instrument-maker to take a steel rod

of about 2 or 3 mm. in diameter, about 20 cm. in length, the distal end of which should be made into a screw form for about 1 cm. of its length. My man made a failure of his undertaking. Dr. McKimmie, grasping my idea, went to his instrument-maker and stayed with him until the instrument was properly completed.

The patient was again brought into the operating-room shortly after 1 P. M. the next day and under cocaine anesthesia, the Jackson tube was again passed through the tracheal wound. The foreign body was engaged in the end of the bronchoscope and the



screw-provided rod was carefully made to penetrate the substance of the eraser. After the rod was apparently firmly fixed, the bronchoscope was removed and the body was cautiously brought to the tracheal opening, where it was lost in the effort to turn it out of the tracheal wound. Several attempts were made at removal, each being attended with failure on account of the screw tearing loose in the effort to deliver the body through the tracheal wound. I then enlarged the opening into the trachea. In my fourth attempt, I succeeded in delivering the body out through the tracheal wound.

When the body was removed, and its size and shape disclosed, I was not surprised at the difficulty of its delivery. It seemed to me that it would be of interest to those present to report the case on account of the large size of the body and for the method by which it was extracted.

The patient made an uneventful and rapid recovery. The body remained in the bronchus for the period of thirty hours, and caused no reaction whatsoever. It gained access to the bronchus by being inspired during an epileptic paroxysm.

1317 Connecticut Avenue.

Cases of Laryngeal Tumor, with Remarks on the Technic of their Removal. PORTER. *Edin. Med. Jour.*, March, 1910.

The cases referred to include three of "singers' nodes," two of papillomata, and one a highly vascular connective tissue growth of doubtful etiology. The last of these occurred in a man, aged 33, whose voice had been hoarse for about 6 months. Examination showed a bluish mass apparently projecting from the ventricle and covering the anterior part of the left vocal cord. It was firmly attached and had to be removed piecemeal with Krause-Heryng forceps, after which it was observed that the edge of the cord on which the growth had rested was bowed. Two days later this bowing had disappeared, and the author believes that it may have been due to stretching of the cord and relaxation of the thyro-arytenoid muscle induced partly by the weight of the tumor and partly by the extra exertion required for adducting the cords; therefore, when the tumor was removed, a few days' rest was sufficient to remedy this. The tissue removed consisted of highly vascular, loose, connective tissue underlying the mucous membrane and containing many hemorrhages. In the three cases of "singers' nodes," the latter were successfully removed with Moritz Schmidt's forceps. The writer employs, and has found very satisfactory, Krause's method of induction of anesthesia by means of a laryngeal syringe, whose nozzle has a very fine orifice.

GUTHRIE.

TWO CASES OF LABYRINTHINE DISEASE FOLLOWING CHRONIC SUPPURATION (CHOLESTEATOMA.)*

BY NORVAL H. PIERCE, M. D., CHICAGO.

Case 1. Male, laborer, aged 47. Suppuration in left ear about 40 years. Ten days before admission to hospital he had an attack of vertigo, which confined him to bed 3 days. Vertigo of a diminished degree was still present, but no ataxia apparent. Patient gave history of sores on penis many years ago, which healed without other manifestations.

Examination: Total defect of left membrane, granulations on promontory, pus from attic. Total deafness. Right tympanic membrane depressed, but intact; low limit of G-2, high limit 4.5, Edelman-Galton. Weber to left. Nystagmus: Spontaneous horizontal to right; slight rotary to left. Rotation to right gave slightly increased rotary nystagmus to left. Rotation to left marked, mixed to right. Caloric (cold) marked on irrigation of right; doubtful on irrigation of left. No fistula symptoms on tests. Dec. 8, 1909, radical operation. Patient took the anesthetic (ether) very badly. Arrested respiration several times. Hemorrhage profuse from soft parts and bone, delaying operative procedures. Some necrosis below knee of Fallopian canal. No fistula found. Cholesteatoma in rather small antrum. Internal ear not opened.

December 11, 1909: Condition excellent. No spontaneous nystagmus.

December 22: After left rotation, rotary nystagmus, to right, 30 seconds. Rotation to right, slight nystagmus, to left. Vertigo absent. Patient complains of a slight dull "drawing" sensation in left occiput. His condition is excellent, has no other complaints and has been walking around since Dec. 13, 1910.

Feb. 16, 1910: Spontaneous rotary nystagmus, left. No spontaneous nystagmus, right, but normal reaction after rotation to left. Rotation in both directions causes vertigo. Rotation to right with head forward 90° , increases spontaneous nystagmus to left. Feels well.

*Read before the regular meeting of the Chicago Laryngological and Otological Society, March 22, 1910.

Feb. 17: Vertigo. Vomiting. Slight delirium. Temperature 100°. Pulse 64. Eyes turn to right.

Feb. 18: Spontaneous horizontal nystagmus to right, practically continuous. Spontaneous nystagmus, rotary to left: longer strokes than right, but not so lasting. Patient, whether he stands or sits, falls to left regardless of position of head. Reflexes approximately normal, but left hand awkward in finger to nose test. Mental sluggishness. Slight delirium and slight thickness of speech. Diaphoresis. Bilateral choked disks. Nystagmus not affected by hot or cold irrigation of left ear. Pulse ranged between 65 and 75. Indefinite tenderness over left occiput.

Feb. 20: Radical labyrinth operation (Neumann's). Chloroform narcosis. Labyrinth full of granulation tissue, flakes of cholesteatoma and pus. Dura of posterior fossa smooth and normal color. No fluid escaped on incision. Thorough exploration of cerebellum in all directions for between 3 to 4 cm. negative. No facial paralysis. Patient died in twelve hours without regaining consciousness, and in convulsions.

Urine occasionally contained albumin, but no sugar or casts. Temperature after first operation, 100° F., dropping to normal on the following day, and remaining so until Dec. 21, when it arose to 99.2°. Thereafter subfebrile, and pulse averaging 90 until Dec. 27, 101.4°, pulse averaging 100. February 17, temperature 100°, pulse 67. Leucocytes, 15,000.

Post-mortem was held on the morning of February 21, 1910. Brain removed and placed in formalin solution. No meningitis. Normal sinuses. Brain, with cerebellum, was cut after some weeks by Dr. Le Count, who reports: In the white substance of the left cerebellar hemisphere a cavity is found containing a fluid which is probably pus, measuring 3 cm. antero-posterior and 2½ cm. from side to side. Inner wall reaches the median line. The lateral wall is 3 cm. from the surface, while the dorsal wall is only ½ cm. below the cortex. The wall of the cavity is of grayish-white color and extends into the cerebellar substance to a depth of from 1 to 2 cm. Outside of this discolored zone is a very narrow hyperemic zone, easily distinguished. The cavity is on its inner surface occupied by detritus which it is impossible to identify without microscopical examination. Evidently an old abscess produced by a microorganism, which occasioned very slight inflammatory reaction in the surrounding tissue. It is probably of haematogenous origin, there being no macroscopic connection between the labyrinthine inflammation and the abscess cavity.

The interesting points in the case are, first, the apparent reaction of the semi-circular canals on the left side to the caloric test. While this was not marked, it was still present, and it would lead one to think that possibly a remnant of function may be present in the static apparatus, even when it is largely destroyed. The patient at no time complained of marked headache, but notwithstanding the fact he must have had the abscess at the time he entered the hospital. Indeed, it is a question whether the abscess did not begin from a thrombotic cortical vessel at the time he had his severe vertigo, 10 days before his admission to the hospital. While it was known that the left labyrinth was involved at the time he was admitted, cerebellar abscess was not suspected.

It is curious to note the disappearance of the symptoms and even the improved condition of the patient after the first radical operation. The recurrence of nystagmus and vertigo followed the day on which the static apparatus was so thoroughly tested, and but for the pathological findings which proved the abscess to be a chronic one, might have concluded that the shaking-up of the diseased static apparatus caused a spread of the inflammation, which led to his death. The case above all accentuates the importance of carefully testing the static apparatus in all cases of chronic suppurative otitis, in order to distinguish in the after-course of the patient between involvement of the labyrinth and the cerebellum.

The question arises as to why the cerebellar abscess was not evacuated at the time of operation. Surely it was not because of lack of thoroughness in exploration. While at the present time I am unable to positively say that the exploring knife entered the cavity, yet I am convinced that this must have happened and that either the fluid making up the contents of the cavity was so thick that it would not flow, or that the peculiarities of the walls closing in immediately after the knife was withdrawn prevented its escape, very much as the corn pulp in our battleships prevents the ingress of water after a perforation of the hull.

Another question which arises is: Was the abscess due to the labyrinthine suppuration or was it hematogenous? At the present time we can positively say that it did not arise directly from the labyrinth, as healthy cerebellar substance to the extent of 3 cm. intervened between the surface in contact with the labyrinth and the abscess wall. Dr. Thor. Rothstein is of the opinion that it is highly probable that the infection come from thrombosis of

the blood-vessels, descending from the cortex in the upper posterior surface of the cerebellum.

Macroscopic examination of the left labyrinth shows that it was full of granulation tissue and pus, and cholesteatomatous tissue. This is now in preparation and a microscopic examination will be made. There was no fistula extending from the posterior surface to the posterior fossa, nor was there apparently any inflammatory reaction in the internal auditory meatus. The labyrinth was probably invaded through the fenestra ovalis, or rotunda, but this point waits microscopic confirmation. The right labyrinth, macroscopically was normal.

Case 2. Admitted January 12, 1910. Male, farmer, aged 21. Discharge from left ear for 15 years. Left ear totally deaf; right ear, whisper 18 feet. Low limit, G-2; height limit, 1. Weber to right. Schwabach + 10 seconds. Rinné, + 15. Left canal constricted. Purulent, stinking discharge. Granulation tissue. No ataxia. No history of vertigo. Spontaneous nystagmus to right. Caloric tests: Left negative; right normal. Rotation to right; very slight nystagmus to left. Rotation to left, nystagmus to right, 30 seconds. No fistula symptoms.

Jan. 15: Radical mastoid. Cholesteatoma. Uneventful course.

Feb. 16, 1910: Vertigo on rotation in both directions. Some spontaneous rotary nystagmus in both directions. Rotary nystagmus to left increased after turning to right. Rotary nystagmus to right increased after turning to left.

March 5: Anode, 7 ma. to left mastoid; nystagmus right. Cathode, 12 ma. to left mastoid; nystagmus left.

Anode, 7 ma., to right mastoid, nystagmus left. Cathode, 12 ma., to right mastoid, nystagmus right.

Nystagmus to left after rotation to right, 20 sec.

Nystagmus to right after rotation to left, 25 sec.

Discharged March 5, with dry cavity; slight moisture from Eustachian tube. Gain in weight.

This is a case in which a serous circumscribed labyrinthitis existed as a consequence of chronic cholesteatoma of the left ear. It is interesting to note the reactions of the labyrinth before and after operation. In this case there was no history of vertigo, which strongly contrasts with the foregoing case. The spontaneous nystagmus to the right is explained by the depressed functional activity of the left static apparatus. The caloric tests of the left would seem to prove this; also the rotation test. This

is against the dictum that a serous labyrinthitis is always irritative, in which event the labyrinth is more easily stimulated than normally.

After the operation the left static function seemed to regain its normal reaction. It is interesting, as exemplifying a case of labyrinthine involvement, in which an operation on the labyrinth is contraindicated.

31 Washington Street.

Conservation of the Mucous Membrane in Intranasal Surgery.

HARRY COULTER TODD, *Med. Herald*, April, 1910.

The author starts out with a history of radical (too radical) nasal surgery, from the spoke-shave of our British brethren, to the submucous resection. As to septum deflections, he very sensibly remarks that: "The method of operation may vary considerably with the same surgeon while operating upon different forms and degrees of deflection. The technic of Sluder, Watson, Gleason Roe, and other rhinologists may all be considered in certain cases: when their operation gives due consideration to the conservation of the mucous membrane and submucous tissues." As to the submucous operation, he has not failed to invent another "self-retaining submucous speculum." There must be a million of these on the market.

Dr. Todd, however, describes an operation, original in technic at least, for reducing the turbinate bodies, while preserving the spongy bodies and mucous membrane. He first strengthens the septum if it is, as so often the case, deflected. After cocaineizing, he makes an incision the entire length of the turbinate about 5 mm. from its inferior margin, and anteriorly outward to the nasal wall. This incision is made deep enough to include the membrane and periosteum throughout its length. With an elevator, the mucous membrane is separated, with the periosteum, from the entire inner surface of the turbinate. With a spoke-shave scissors or forceps the desired amount of the bony edge is removed, the flap of membrane and periosteum is allowed to fall into place, and retained there by a rubber tube inflated with air. Union is by first intention.

EATON.

ERYSIPELAS AS A COMPLICATION OF MASTOID DISEASE.*

BY GEO. L. RICHARDS, M. D., FALL RIVER, MASS.

In 1907, Dr. C. R. Holmes, of Cincinnati, published a most elaborate paper on the etiology of erysipelas and its relation to the nasal cavities. This paper was based on a comprehensive study of the literature of the infectious organisms present in the upper air tract, supplemented by a large number of clinical reports, both published and hitherto unpublished, showing the presumptive relation of facial erysipelas to infectious diseases of that portion of the mucous membrane of the upper air tract which has continuity of surface; namely, the nasal passages with their accessory cavities, Eustachian tubes, mastoid cells, the fronto-nasal ducts and conjunctivae. These studies show that streptococci are nearly always present somewhere in this region, their pathogenicity varying considerably; in some cases largely losing their naturally virulent character, but probably becoming more virulent when planted on more suitable soil. In other words, the individual becomes practically immune to them at the site of their original location but is not immune to the same streptococcus when transplanted to another place, and when the resisting power of the individual is for any cause reduced.

Dr. Holmes recorded 102 cases of facial erysipelas occurring in connection with disease of the nose and accessory sinuses or following upon acute and chronic mastoid disease. These cases occurred in the practice of 69 American surgeons. They do not include those cases of the same character gathered from the literature. His conclusions were that the identity of the streptococcus as the microbial cause of erysipelas seems now to be a definitely established fact. This streptococcus is of slow growth and of variable morphology and pathogenicity whenever its environment is changed. It is probably but rarely air-borne, requiring direct personal contact for its transference.

The streptococcus is of nearly constant presence in the normal nose and neighboring spaces. It may be latent for months or years without betraying its presence, but this quiet existence may

*Read before the Sixteenth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Washington, D. C., April 29, 1910.

be broken at any moment by some temporary or unknown cause, inducing virulence in the microorganism through some unfavorable condition supplying the environment necessary to incite the organism into virulence, with the attendant formation of toxins. The extreme frequency of facial erysipelas has been noted for many generations, and Dr. Holmes' studies showed an apparently causative relationship between facial erysipelas and suppuration in the regions studied. Even in those cases in which no bacteriological examination was made, there was sufficient presumptive evidence to assume that the erysipelas-producing streptococcus was probably present in the discharges of the disease which was under treatment at the time of the appearance of the erysipelas. These cases of erysipelas occurred in the hands of careful surgeons, were not due to neglect, occurred in hospitals some of which were new, in others where no cases of erysipelas had occurred for many months, and unless some such explanation as this satisfies, the cause must be regarded as unknown.

In most of the cases reported from the statistics gathered by Dr. Holmes, the erysipelas does not seem to have had any serious effect upon the progress of the original disease. There were 12 deaths, but only in 5 could it be said in fairness that the erysipelas was the cause of the fatal result.

Observations of substantially the same character as those of Dr. Holmes are also made by Welty in an article on "Acute and Chronic Suppuration of the Ear and Nose as the Direct Cause of Facial Erysipelas," presented before the Section on Laryngology and Otology of the American Medical Association in June, 1906.

In addition Welty thinks that epidemics of erysipelas are nothing more than direct wound infection carried by surgeons or nurses, and that the so-called idiopathic erysipelas is a misnomer. The fact that erysipelas does not occur in every case of streptococcus infection is due to the character of the streptococcus and the immunity of the patient. Assuming these observations to be correct, the practical conclusions would seem to be:

1. The occurrence of a case of facial erysipelas in a hospital ward is not of necessity any reflection on the surgeon or the hospital, as it arises in nearly every primary case as an auto-infection.
2. Erysipelas is probably much less contagious by direct contact than has been supposed and should therefore be less feared; nor is there much likelihood of an epidemic of erysipelas occurring from a single case of erysipelas, provided the infection is not transmitted by the attendants, instruments, dishes, etc.

3. As a routine measure in all operations on the mucous membrane of the upper air tract it would be advisable before operation to cleanse the nose as carefully as possible, though it is by no means asserted that thereby every streptococcus or pneumococcus germ can be destroyed.

The three cases now to be described I offer as a contribution to the clinical history of facial erysipelas and as substantiating the foregoing conclusions. This point of view of the general etiology of erysipelas does not seem to have been as yet sufficiently grasped by the general surgical profession. In a very recent article on erysipelas in a general medical encyclopedia, no mention is made of this theory of the causation of facial erysipelas.

Case 1. M. J. D., 55 years of age, though looking much older; slight tendency to alcoholism; otherwise, general health good. First seen, April 5, 1908, complaining of otitic media; next day incised the drum; following day, ear discharging freely, some mastoid tenderness; noticed for first time erysipelas blush at the outer angle of the left nostril. This slowly involved the entire left side of the face, reaching the region of the mastoid last of all, extending from this point backward to the mastoid and the corresponding side of the neck, temperature going to $104\frac{1}{2}$ and becoming normal on April 15. The erysipelas lasted about 10 days, the blush disappearing in about a week.

By April 29, the erysipelas had completely cleared up, the ear was discharging, there was considerable loss of tissue of the membrana tympani. During all this time there had been mastoid tenderness. On May 7, a thorough operation for acute mastoiditis was done. The mastoid was very large and very cellular, and there was a purulent debris in every cell. Recovery slowly took place, the last filling-in not being completed until June, owing to the presence of a small bit of carious bone tissue corresponding to the roof of the antrum cavity. This was finally curetted away, uncovering the dura for a short space, after which the cavity promptly filled in.

Now as to the relation of cause and effect. At the time of the advent of the erysipelas no one connected with the case had had anything to do with a case of erysipelas for months. The patient was at his own home, so there could be no hospital infection. It seems to me probable that the patient with his own fingers carried the infection from the ear to the corner of the nose, probably with the finger nail. This is the more likely as he was inclined to feel

around his ear with his fingers, and at first the ear was only wicked and not bandaged. I do not think the erysipelas caused the mastoid, as I was suspicious of beginning mastoid before the erysipelas began. The patient and his family physician were both loth to have the mastoid operation done, and he was out and about and came to my office after the subsidence of the erysipelas; the discharge and the mastoid tenderness continuing until the operation was finally done. The erysipelas was due to direct infection from the purulent discharge of the middle ear.

No bacteriological examination of the discharge was made, but on account of the extensive destruction of the mastoid and the subsequent slow recovery, the presumption is all in favor of the streptococcus infection.

Case 2. T. P. S., a dentist, aged 33, was operated on at St. Anne's Hospital for an acute mastoid on February 23, 1908. The operation had been delayed, owing to failure of the patient to give his consent, and the mastoid, which was large, was very much broken down, every cell in every direction being involved. After he had begun to leave the hospital and come to my office for treatment, but while the posterior wound, especially in the attic region, was still open, he developed about April 1, a facial erysipelas, invading the entire left side of the face, front and back, and going nearly to the vertex. It ran the usual course of an erysipelas, seeming in no way to interfere with the healing process of the mastoid. There was no other case of erysipelas in the hospital, nor was there any reason to suspect that either the surgeon or any attendant had carried the disease to the patient. Unfortunately, no bacteriological examination of the ear secretions were made; but from the intense degree of infection and tedious convalescence, it is probable that the case was one of streptococcus infection from the ear secretions. Recovery from the erysipelas took place after the usual time and the mastoid wound healed perfectly.

Case 3. Captain H., aged 65, retired officer of the United States revenue cutter service, had suffered for many years from an empyema of the right antrum. On January 22, 1910, an operation was done through the naso-antral wall, a portion of which was cut away so as to give permanent drainage. The after-treatment of this was uneventful for the first few days, and the patient was up and about, coming to the office for treatment. On January 31, nine days later, he developed facial erysipelas in the same side from an abrasion at the angle of the nose. The erysipelas was at

first on this one side, then involved the whole face. This ran the usual course and in the convalescent stage he seemed to acquire a general streptococcus infection and was quite sick for a number of days. No case of facial erysipelas had been recently seen, either by his family physician or myself. The amount of pus in the antrum was small, but there is little doubt but that the infection came from the nasal or antral secretions.

A coincidence, and perhaps in the nature of cause and effect though I am by no means certain of it, is the fact that my office assistant, who cleaned up the instruments after an examination of the nose at the time that this case of erysipelas was in the early active stage, herself developed erysipelas of the face 9 days later. The physician who attended her, however, did not believe that she got the infection from this source, as he had under treatment two or three cases of sporadic erysipelas at the same time. She left work complaining of fever and rheumatism, the erysipelas developing two or three days later. The disease ran the usual course and she was not very ill.

These cases are offered as a contribution to the subject of the etiology of facial erysipelas. The possibility of its occurrence after operations or infection of the upper air tract and adjacent communicating regions is to be borne in mind, though its occurrence under such conditions may be unavoidable.

84 North Main Street.

Scab Formation in the Nose. W. P. PORCHER, *Jour. A. M. A.*,
Aug. 13, 1910.

Porcher recommends the use of potassium iodide in atrophic rhinitis, as it opens the accessory sinuses, gives free outlet to all inflammatory exudates, and produces lacrimation. It must be given in increasing doses, varying according to the individuals. Some patients absorbed 600 to 900 grains a day before the nasal secretions remained fluid, yet no painful effects were noted from these large doses.—Ed.

**THE ETIOLOGY, PATHOLOGY, SYMPTOMS AND DIAGNOSIS
OF PHLEBITIS AND THROMBOSIS OF THE BLOOD-
VESSELS WHEN COMPLICATING PURULENT
OTITIS MEDIA.***

BY WENDELL C. PHILLIPS, M. D., NEW YORK.

ETIOLOGY: Thrombosis of the lateral sinus is induced either by means of (a) an extension of the infective process within the temporal bone through the smaller veins, whereby the latter become involved with septic thrombi which gradually extend to and infect the sinus, or, (b) the infection in the bone extends by contiguity, directly through its internal table to the walls of the blood-vessel, where its further advance is characterized by infection of the sinus walls, and thence into the blood stream with resultant thrombosis.

Furthermore, according to Bönninghaus, thrombosis may occur from infection located within the labyrinth. In these cases the sinus is usually affected below the knee, or through involvement of the superior or the inferior petrosal sinuses. In another group of cases, the infection proceeds from a labyrinthine infection directly toward the bulb, through involvement of the lymph spaces of the middle-ear, or through the extension of the thrombus from the internal auditory vein.

From the tympanic cavity proper, a thrombosis of the jugular bulb may take place from direct infection through dehiscences in the floor of the tympanum. McKernon and others have reported cases of primary jugular bulb thrombosis. Bönninghaus, Körner and others report cases wherein the infection entered the jugular bulb from the tympanic cavity proper through involvement of the carotid plexus, along the anterior wall of the tympanic cavity. We conclude, therefore, that phlebitis and thrombosis of any part of the lateral sinus and internal jugular vein takes place as follows:

(1.) Through anatomical dehiscences in the bone tissue which covers its parietal surface, thus affording easy access for the pathologic process.

(2.) Through the direct extension, into its walls, of the active purulent lesion in the bone.

*Read before the meeting of the Eastern Section of the American Laryngological, Otological and Rhinological Society, Watertown, N. Y., January 15, 1910.

(3.) Through involvement of the smaller veins in the diseased bone, or through the involvement of intermediate anastomotic veins in the thrombotic lesion.

PATHOLOGY: When the walls of the sinus become the seat of an inflammatory lesion, and when the inflammation has penetrated to the inner, endothelial lining of the blood-vessel, it causes a deposit of fibrin in the lumen of the sinus, as a result of the inflammation, the fibrin being derived from the blood-current.

This deposit is attached to the vessel wall at the site of the lesion. Pathologically, there results what is designated as a "white wall thrombus," (Heine, Bönninghaus).

In the course of time, this wall thrombosis grows larger and narrows the lumen of the vein until finally it becomes completely occluded. The fibrin then becomes mixed with coagulated blood, and assumes the form of a "red obstructive thrombosis," which may obstruct the vessel's course for a variable distance.

The thrombus, in a backward direction, may involve the superior petrosal sinus, the mastoid emissary vein, the torcular Herophili, the longitudinal sinus, and even the lateral sinus of the opposite side, while in the opposite direction it may involve the inferior petrosal and cavernous sinuses, the ophthalmic vein, and after transversing the jugular bulb continue throughout the jugular vein and its tributaries.

Thrombi, both of the wall type and the obstructive type, may either be of infectious or non-infectious character, the latter occurring but seldom.

If the thrombus is not infected it becomes organized through the advent of connective tissue. On the other hand, if it becomes infected, it eventually breaks down, spreading the infection along the sinus walls, and finally destroys these walls to a variable extent.

If parts of the broken-down thrombus are carried into the blood stream, then septic emboli result. These may find lodgment in the lungs or in other parts of the body, setting up inflammatory lesions at their points of lodgment.

SYMPTOMS: The symptoms of lateral sinus thrombosis are fairly constant, and for convenience of description are divided into (1) those manifested locally, and (2) those due to the infection of the general system.

LOCAL SYMPTOMS: Patients having sinus thrombosis occasionally present a swelling behind the mastoid process. (The Grie-

singer sign). This swelling or edema of the region behind the mastoid process usually is painful to the touch, especially at the mouth of the mastoid emissary vein. It seems to indicate at least a perisinus abscess, or a phlebitis of the mastoid emissary vein. This symptom is not to be considered as invariably characteristic of lateral sinus thrombosis.

Bönninghaus has noted a thickening of the vena mastoidea as indicative of sigmoid sinus thrombosis; and, finally, the finding of a rather thick strand which is painful upon pressure, or to the touch, along the upper portion of the jugular vein, when accompanied by other symptoms of the disease, is indicative of a thrombosis in this vein.

Rarer findings of a local nature have been noted in pain along the back of the neck. This was presented in a case where the thromboses extended to the emissary condyloïdæ. Edema and swelling in the skin of the scalp has been observed in connection with thrombosis of the lateral sinus. A thrombosis which extends to and involves the cavernous sinus, induces edema of the eye-lids, chemosis and exophthalmus. Kümmell found paralysis in the larynx and of the muscles of deglutition, without local cause, in thrombosis of the jugular bulb. Unilateral laryngeal paralysis with retarded pulse has been noted in rare cases where the thrombus exerted pressure on the ninth and tenth cranial nerves in the Foramen Lacerum Posticum. (Bönninghaus).

In 1898, Voss stated that the bruit of the blood in the sinus ceases in cases of thrombosis. This local sign Körner, 1899, substantiated in personal observation. The bruit is listened for with a stethoscope, and comparison is made with the sounds heard in the healthy side.

Finally, Libman of the Mt. Sinai Hospital, New York, has published observations in which he holds that the finding of streptococcus in the blood-stream, when all other possible sources of origin of the bacteremia are eliminated, indicates a sinus thrombosis. In all of his published cases the positive findings of streptococci in the blood, by culturing the blood (after withdrawal from the vein), were substantiated upon the operation by finding the sinus thrombotic. On the contrary, at the Manhattan Eye, Ear and Throat Hospital, New York, where a series of blood cultures were made from patients suffering from suppurative purulent otitis media, by Jonathan Wright and reported by Duel, the findings showed that in the relation of streptococcemia to sinus thrombosis

the finding of streptococci in the blood-stream did not indicate sinus thrombosis in all the cases in which the sinus was explored; and, furthermore, streptococcemia was discovered in many patients with flat temperatures and no other co-existent signs of sinus thrombosis. Nor could endocarditis or other lesions which might have accounted for the bacteremia be demonstrated.

In the present state of the subject we do not feel that we are justified in saying that the finding of streptococci in the blood necessarily means the existence of a sinus thrombosis, even after all other sources of the bacteremia are eliminated. When, however, in addition to other classical signs, the blood shows streptococci, this finding then furnishes conclusive corroborative evidence of the presence of a thrombus. Marked leucocytosis and a high polymorphonuclear percentage are among the associated symptoms.

GENERAL SYMPTOMS: Of the general symptoms of sinus thrombosis the most important in typical cases is fever. Fever is almost a constant symptom of sinus thrombosis, but occasionally in atypical cases it is absent. The fever is the result of the invasion of the system, probably through the blood streams, by bacteria. During the early stage of the attack the fever is characteristically pyemic. Usually the patient has a distinct chill, during which the temperature suddenly rises from 103° to 105° , but after a short time it recedes to normal or sub-normal, only to rise again upon the advent of a subsequent chill, fluctuations not being marked by any period of regularity. As the temperature falls, the patient sweats profusely. In the last stages sweating may be constant.

In a typical case the patient may complain of feeling chilly, and then the temperature rises to 103° , 104° , or as high as 106° , where it remains with slight variations only. This is the rarer type and is generally significant of secondary metastatic involvement. Vomiting of a projectile type may accompany the chills, but it is not a constant symptom, and furthermore it may occur in all the forms of intra-cranial complications of otitic origin.

The next most important symptom to that of fever is the clinical picture produced by varying metastatic lesions. According to Bruger, these take place in 42 per cent of the cases. The most common secondary lesion is that involving the lungs. This is indicated by pain in the chest and the advent of coughing. The lung lesion is often broncho-pneumonia. A rarer lesion is abscess of the lung. Then hemorrhagic sputum of foulest odor is noted. The infarct

may lodge in the pleura, causing a pleurisy, pyopneumothorax, or the joints may become involved. The peri-articular mucosa may be involved, and finally lesions may take place in the heart, the kidneys, or the brain, each organ portraying distinctive symptoms.

Headache usually is present during some period of the disease, and is located about the mastoid, parietal and occipital regions of the affected side. Swelling of the spleen also is commonly noted. The mentality of the patient may vary from being absolutely unaffected during the early stages to coma just preceding death. In general, the patients feel very sick, have no appetite, show a coated tongue, gradually lose weight and assume the appearance of typhoid fever patients.

Finally, the color of the skin and conjunctiva changes to a yellowish tinge, and the clinical picture of meningitis or brain abscess is intensified, which continues, unless relieved surgically, to the death of the patient.

Usually the disease runs its course in from 8 to 14 days. Cases of primary jugular bulb thrombosis when occurring in infants and young children, present typical symptoms, inasmuch as no disease of the mastoid process is present, and furthermore, the symptoms are similar to those which accompany pneumonia, malaria, typhoid fever and affections of the digestive tract. In infants and young children the chief symptom of thrombosis of the jugular bulb is a sudden and rapid rise of temperature to above 104° , followed by an equally precipitous decline. Thereafter the temperature curve fluctuates after the manner of the first rise, during which time the variations in the pulse rate follow the temperature. There is no chill. The hands and feet may be cold when the temperature rises. Meanwhile, during the earlier remissions, the child appears quite normal, playing with its mates and taking liberal nourishment. Later on prostration ensues and all the symptoms of sepsis become apparent to be followed by a fatal issue unless an early diagnosis is made and prompt surgical treatment intervenes.

DIAGNOSIS: Bönninghaus lays down the four following propositions regarding the diagnosis of sinus thrombosis:

1. When, after an acute middle-ear and mastoid involvement, in spite of adequate drainage (surgical treatment) the fever recurs after having dropped, then we should be suspicious of sinus thrombosis. Especially is this true if the temperature elevations persist over a number of days, and become higher as succeeding days pass. That fever often persists for some days after a mastoid

operation, and is especially prone to persist in the case of children, has been shown by Harris.

2. If the fever re-appears after an interval of normal temperature, which has followed the procuring of adequate middle-ear drainage (mastoid operation, etc.).

3. When fever suddenly re-appears after a case of middle-ear infection apparently has been cured for some interval of time.

4. When, in cases of chronic middle-ear suppuration having marginally situated drum perforations, there is a sudden appearance of fever, then sinus thrombosis is to be suspected.

Regarding Bönninghaus' diagnosis, based upon the time and advent of fever, it must be borne in mind that all other sources of the fever first must be eliminated in order to make his four propositions hold true. Of especial significance is this observation when dealing with cases occurring among children.

In a more detailed consideration of the diagnostic points, it is found that in typical cases which present the entire category of signs and symptoms, lateral sinus thrombosis is not difficult to recognize. The characteristic temperature curve, the chills, the sweating, the vomiting, the localized pain over the sinus walls, the leucocytosis, the high polynuclear percentage, the bacteremia, together with the history of purulent otitis media and mastoiditis, furnish an unerring clinical picture of this affection. Unfortunately, in a large percentage of even the so-called typical cases, one or more of the above-named symptoms are absent in which event it becomes more difficult to render a diagnosis.

In atypical cases the diagnosis is difficult and requires an exhaustive consideration of the entire chain of symptoms, meanwhile taking advantage of blood culture, blood examinations and all known methods whereby other diseases may be eliminated. A high temperature continuing several days after a mastoid operation, especially when the operative findings have disclosed areas of necrosis of the bony covering of the lateral sinus, and examination of the blood shows bacteremia, leucocytosis and a high polynuclear percentage, is indicative at least of an infective process of sufficient severity to constitute sinus thrombosis, and the sinus should be examined.

The diagnosis of primary jugular bulb thrombosis must largely depend upon the sudden rise in the temperature range, and the subsequent fluctuation from normal or sub-normal to 104°, 105° or 106°. Usually occurring in infants and young children, and

often without intercurrent mastoid infection, the early diagnosis is most difficult and must be made only after eliminating other diseases such as pneumonia, malaria, typhoid fever, and digestive disturbances. Blood examination also furnishes reliable data.

The operative findings, both when the sinus is exposed for purposes of diagnosis and when necrotic areas of its bony covering are discovered during the progress of the mastoid operation, are of considerable diagnostic value, as occasionally a thrombus in the sigmoid region is discovered only at the time of operation. Whenever an exposed area of the sinus is covered with healthy granulations, its interior should not be disturbed unless other signs and symptoms of thrombosis are present. When after removing a necrotic area of the bony covering of the sinus, the sinus wall at one or more points presents necrotic or sloughing spots and much epidural pus instead of the smooth, slightly shining blue surface of a normal sinus wall, then there is a strong probability that the infection has already invaded the blood current within. Palpation of the sinus wall is an uncertain diagnostic measure inasmuch as pulsation may still continue after a mural clot of considerable size has formed. If pulsation is absent and the pressure sensation is doughy, a thrombus may be expected.

An occluding thrombus occupying the lateral or sigmoid sinus may exist without producing any symptoms referable to the internal jugular vein. The local diagnostic signs of thrombosis of the internal jugular vein—and they are by no means constant—are pain and tenderness extending along the pathway of the vein, the absence of venous bruit, swelling of the cervical glands, a cord-like sensation, evoked by palpation along the thrombosed vein, the fixed position of the patient's head which bends toward the affected side, and finally reflex phenomena from compression of regional nerve trunks.

Reverting to the diagnosis of lateral sinus thrombosis in general, emphasis should be placed upon the importance of early diagnosis, inasmuch as the mortality in cases surgically treated is in direct proportion to the duration and extent of the disease.

PROGNOSIS: The prognosis of lateral sinus thrombosis depends upon the duration and extent of the disease, and upon the stage at which further progress is checked by surgical interference. The earlier the operation the lower the mortality. A localized thrombus of short duration, when located in the region of the sigmoid, and therefore unaccompanied by involvement of the petrosal sinuses or

jugular bulb, when operated upon promptly, usually results in recovery; whereas, during the later stages, after the thrombus has invaded the contributing branches the torcular, the bulb or jugular vein, the prognosis is less favorable and the mortality is high. After metastatic abscesses have formed in the lungs, brain, spleen, bowels, etc., the mortality is extremely high.

There is considerable evidence in published reports to warrant the opinion that certain individuals possess sufficient resistance to the infection to enable them to counteract its effects without the formation of thrombi. Once formed, however, a thrombus is prone to suppurate and break down, often with a partial or total destruction of the sinus wall and subsequent purulent inflammation of the surrounding tissues. The writer has during the process of operations upon the mastoid process found the sinus walls enormously thickened and its lumen nearly or quite obliterated, and still without any visible clot.

40 West Forty-seventh Street.

Effects of Tobacco on the Ear and Upper Respiratory Tracts.

H. O. REIK, *Boston Med. and Surg. Jour.*, June 23, 1910.

Reik asserts that it has not by any means been proved that tobacco causes any definite characteristic lesions of the nose, throat or ear. Though it is possible that an excessive use of tobacco may, by indirect action, have a toxic effect on the olfactory and auditory nerve, with resulting impairment of those senses, yet there is no laboratory proof for such a conclusion. The ill-effects of tobacco upon already existing diseases of the throat is established, as is also the fact that nicotine, together with other poisonous substances evolved in tobacco-smoke, such as CO, are injurious, causing gastric and systemic nervous disturbances. Cigarette smoking is only more injurious than pipe or cigar-smoking if the smoke is inhaled.—ED.

A CASE OF ABSCESS OF THE LEFT TEMPERO-SPHENOIDAL LOBE.*

BY ADOLPH O. PFINGST, M. D., LOUISVILLE.

Male, 48 years old, huckster, referred to me by Dr. Thos. A. Hays, October 23, 1907. From his wife it was learned that he had had measles when 8 years old and since then his left ear has discharged pus, which at times was very offensive. He has never had earache or any symptoms referable to the discharging ear until very recently. Although thin, he has always been muscular and his general health has been very good, having lived an outdoor life, which exposed him to all kinds of weather. His habits have been good. His mind has always been clear and he was quick-witted and industrious in his business up to two years ago. Since then his wife has noticed that his memory has been failing, especially in the last year. For a year he has also had frequent attacks of headache, especially on the left side, quite pronounced at times. Although formerly a very mild-tempered man, his wife recalls that he has in the last year shown evidences of temper which have on occasions been manifested in almost a rage. The discharge has been less frequent in the last year than formerly.

Two weeks ago the patient was suddenly seized with severe pain in the left temporal region and vertex. Four days later he had a marked chill of 45 minutes' duration. Since then he has been drowsy the greater part of the day and has shown signs of mental disturbance, manifested in a listlessness and an inability to name persons and objects, although apparently able to recognize them.

Examination of the patient showed him to be rather listless and not promptly responsive to questions, although seemingly to understand them. When asked to get up he did so briskly with regular movements, walking across the floor and seating himself close to a light as he was asked to do for an examination of his ears. He seemed to recognize objects and be able to indicate that he understood what they were, but could not call them by name. When a knife was held up before him he would say "cut"; a glass of water he would say "drink"; his hat he would say "out," etc. Although he was unable to recall names of objects spontaneously, he

*Read before the meeting of the Jefferson County Medical Association, Louisville, June 20, 1910.

would rapidly do so when they were named for him. In shooping flies from his face he would speak of the "rats" bothering him but would repeat "flies" when corrected. He could write when dictated to or when shown copy, but not spontaneously. There was no disturbance of motion.

A scant amount of clear fluid of very foul odor was present in the left ear canal. There was no swelling of the canal. The posterior inferior quadrant of the drum had a small clear cut perforation. There was no tenderness over the mastoid process, no sensitiveness on percussion over any other part of the skull. There was no dizziness or nausea. Temperature 100°, pulse 75. Eyes showed no changes in the fundi. His hearing was very defective, the loud voice being recognized when spoken close to the ear.

October 24. Patient was removed to the infirmary. His general condition was about as on the previous day. He complained of pain in the left temple, but there was no sensitiveness on percussion. He remained quietly in bed but was apparently very sensitive to noises, the hammering of carpenters in an adjoining room causing him severe pain. He became very angry when asked many questions. There was no nausea, no vomiting, no other disturbance. Pulse continued 75; temperature 100°-101°; pupils regular and responsive, fundi normal. Diagnosis of left temporo-sphenoidal abscess was corroborated by Dr. J. M. Ray, who saw him on this day, and operation decided on.

Operation, October 25, under chloroform narcosis. A large curved incision was made behind the left ear extending from the tip of the mastoid to the temple, $\frac{1}{4}$ inch in front of the auricle, another extending from the middle of this incision upwards and backwards about 2 inches. The soft parts including considerable of the temporal muscle were elevated, thereby exposing a large area of bone. The radical mastoid operation was performed before search was made for the intra-cranial abscess. The bone was very hard, contained no cancellous tissue, the antrum was deeply situated, from $\frac{1}{2}$ to $\frac{3}{4}$ inches from the surface. It was very small and contain foul pus and cholesteatomatous membranes.

After removal of the posterior superior wall of the osseous ear-canal and cleansing the tympanum and antrum, the roof of the antrum was removed and the middle cranial fossa entered, allowing about two drams of very foul yellowish pus to escape. Subsequent removal of bone forwards disclosed the avenue of infection in a necrotic tegmen. Bone was also removed upwards and backwards

to beyond the limits of the subdural abscess, which was recognizable by the dirty greyish-green discoloration of the dura. It extended over an area of about $1\frac{1}{4}$ inch in diameter. Near its posterior boundary a very small fistula was found in the dura from which a watery fluid of very foul odor exuded when pressure was made over the discolored region. The membrane was adherent to the brain surface. A crucial incision was made through the discolored area and a large pair of forceps spread in the cavity, emptying it of about 2 or $2\frac{1}{2}$ ounces of grumous, dirty green, extremely foul contents. It was not possible to determine the size of the cavity nor the condition of its walls, but it was apparently the size of a hen's egg and seemed to be separated from the dura by a thin layer of brain substance. The cavity was not irrigated. Two large rubber drainage tubes were inserted besides strips of gauze. The upper part of the skin-section was closed, the drainage tubes sutured to the skin and gauze dressing applied. The pulse was from 75 to 80 after the skull was entered and remained so until the patient was returned to his bed.

With the exception of the aphasia the patient was almost normal on the day after the operation. There was no sign of nausea and he begged for food continuously. Temperature 99° , pulse 78. From this time until January 10, 1908, the wound was irrigated with a solution of permanganate of potash (1 gr. to pint) every other day, the dressings having become extremely offensive. The drainage tubes were shortened as the cavity became more shallow and after several weeks the cavity in the tempero-sphenoidal lobe was packed loosely with gauze. During this time a small cerebral hernia developed, but gradually receded. The discharge of foul pus continued, although the opening in the brain was becoming smaller and the opening in the dura was gradually drawing together. The general condition of the patient improved rapidly. His mind seemed active, his headaches disappeared and he was regaining the power of naming objects slowly.

About January 10, 1908, he showed signs of returning sluggish mind and some headache. For 2 weeks the temperature varied between 99° and 100° , pulse between 75 and 80 and the mental condition slowly grew worse, making a second operation imperative. This was done on January 24, 1908.

From the fistulous opening in the soft parts an incision was extended upwards for an inch and another backwards for the same distance and the skin retracted. The fistula led to the dura, which,

when exposed, appeared thickened and red and had apparently completely reformed. It was with much difficulty that a fistulous opening not larger than a pin-hole was found in the middle of the field. This time a button of dura about one inch in diameter was excised and quite a quantity of foul pus and necrotic brain-matter was removed with a dull curette until two fingers could be inserted into the pus cavity to the depth of about $1\frac{1}{2}$ inches. No sutures were placed in the skin and the wound was packed loosely with gauze. The wound was dressed every other day and irrigated with permanganate of potash solution, the cavity gradually filling in from the bottom and in about 3 months the wound closed, leaving a dry ear-canal and no fistula anywhere. By that time the aphasic symptoms were considerably improved, but had not entirely disappeared. Frequently, in endeavoring to use a word, the patient would say: "I know what I want to say but I can't say it."

The patient to-day, about $2\frac{1}{2}$ years after the second operation, is apparently in perfect physical condition, notwithstanding a syphilitic infection and marked secondary eruption a year ago. His ear is dry and he hears the loud voice. Outside of an occasional moment of hesitation when asked to name objects his aphasia has disappeared.

In presenting this case I would call your attention to some of its interesting features. The seat of the trouble in the tempero-sphenoidal lobe represents the point of predilection for brain abscesses of otitic origin, most statistics showing its presence there twice as often as in the cerebellum.

It is probably not new to you that a large percentage of cases of otitic brain abscess complicate the chronic suppuration of the ear, only 9 per cent of all cases reported having occurred in acute cases. They may come on after years of otorrhea, one case having been reported in an individual who had been troubled with running ears for 44 years (Schwartz).

As the cases often develop without pronounced symptoms, the average time of formation has not been determined, although it is generally believed that, as a rule, they develop slowly. In this connection I would point out the probable slow development of my case as indicated by the occasional headache and the paroxysms of anger for two years.

Comparing the symptoms in this case and the symptoms of brain abscess as grouped by Von Bergman, we find no *general symptoms* as prostration, malaise, loss of energy, loss of appetite, progressive emaciation, constipation, fever, etc.

Of the *brain pressure symptoms* enumerated by Von Bergman, as early headaches (continuous or intermittent, localized or general), tenderness on percussion over the region of the abscess, vertigo, nausea, vomiting disturbance of sensorium, lethargy, slow cerebation, slow pulse, choked disc, etc., our case presented only the headache and one of the less frequent phenomena, the irritability and paroxysms of temper. Neither of these symptoms were pronounced and their presence for about two years was not recalled by the patient's wife until she was questioned about their occurrence.

In the 2 weeks before the operation the patient developed more manifest pressure-symptoms in the slow cerebation, the chill followed by fever, and severe continuous headache, although even at that time there was an absence of nausea, vomiting, vertigo, convulsions, choked disc and changes in respiration. The slow pulse indicative of intra-cranial pressure was also absent. The slow development of the abscess with the production of few general or intra-cranial pressure-symptoms and its large size are interesting clinical features of this case.

Of Von Bergman's third group of symptoms—*localizing brain symptoms*—in which he included focal symptoms due to disturbed nerves in their course or lesions of the motor and sensory center manifested in motor paralysis or disturbed special senses, our patient had only the aphasia. It was by means of this that a positive localization of the trouble could be made in the left temporo-sphenoidal lobe.

The aphasia in this man was of the kind first spoken of by Freund as optical aphasia and later by Starr as intercortical sensory aphasia, and is characterized by the inability of the patient to recall the names of objects seen or things heard, though there is a comprehension of objects seen and of spoken words as indicated by signs or by writing. The impulse from the word-hearing center cannot arouse the visual memory, nor can the association be made in the opposite direction. The lesion involves the tract between the temporal and occipital lobes of the left hemisphere.

It is of interest to note that although the aphasia practically disappeared, it took a long time and even now, after 2½ years, there is some tendency to miscall names of objects occasionally.

One of the surgical features of this case was the rather large extra-dural abscess leading from the point of infection above the attic to the fistula leading through the dura. According to Körner,

Pitt and others, the presence of an extra-dural abscess seldom exists in cases of brain abscess.

The re-closure of the dura notwithstanding an effort to keep the wound open, thereby allowing a reformation of the abscess cavity and recurrence of pressure-symptoms necessitating a second operation is also noteworthy.

The final closure of the wound without remaining sinus is worthy of mention and can be explained in the approach of the abscess through the mastoid and removal of enough of the roof of the attic and antrum to establish drainage from the dependant part of the abscess, and also by the performance of the radical mastoid operation, thereby assuring free drainage of the middle-ear and cure of the otorrhea and removing the probability of subsequent re-infection from this source.

Atherton Building.

Neuralgias and Functional Disturbances Arising from Infections in and About the Tonsil. E. C. TODD, *Jour. A. M. A.*, Aug. 27, 1910.

Frank C. Todd: 1. Pain and soreness in the neck in the region of the tonsils usually arise from diseased tonsils. 2. Neuralgias in the region of the tonsil, ear, side of head, neck, nose, teeth, gums, or antrum of Highmore, may be and frequently are caused by diseased tonsils. 3. Disturbances of function through pressure on or inflammation of nerves may manifest themselves in hoarseness, in loss of voice, cough, difficult deglutition, or entrance of food into trachea with regurgitation, or in defects in hearing, dyspepsia and disturbed heart action. 4. Such diseased tonsils may not be and usually are not large or acutely inflamed. They must be carefully examined by the surgeon who should pull them into view with a dull hook, determine whether the crypts contain detritus, whether the tonsils are sore to such manipulation, bleed easily, or otherwise give evidence of being diseased. 5. Such tonsils should be carefully and completely removed. 6. Relief of secondary infections usually follows immediately on removal, but, sometimes, only slowly, if neuritis or secondary glandular involvement is present. 7. In certain cases paralysis may be permanent.

SPECIAL EDITORIAL DEPARTMENT

THE DEAF

**Their Education—Improvement of Conditions—
Responsibilities and Participation of the Profession**

EDITED BY

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"The problems of deafness are deeper and more complex, if not more important, than those of blindness. Deafness is a much worse misfortune, for it means the loss of the most vital stimulus—the sound of the voice, that brings language, sets thought astir, and keeps us in the intellectual company of man."

Helen Keller to Dr. James Kerr Love, Glasgow, April, 1910.

The aim of this department of THE LARYNGOSCOPE will be to bring to the notice of its readers from month to month facts that may be helpful to physician and patient in dealing with the life-problems involved in deafness.

The department is an innovation and the line of greatest usefulness can only be determined by experience. Any suggestions from readers will be gladly received and all questions answered to the best of our ability.

At the meeting of the Otological Section of the American Medical Association, at Atlantic City, in June, 1909, after the reading of a paper by Prof. John Dutton Wright on "The Deaf Child and the Physician," a movement was set on foot to arouse a greater interest in ameliorating the condition of the deaf by educational means; by motion of Dr. D. Bryson Delavan, of New York, a committee consisting of Drs. John C. Adams of New York City, R. B. Shurly of Detroit, Dunbar Roy of Atlanta and Max A. Goldstein of St. Louis

was appointed to draft resolutions for that purpose and to report at the next annual meeting of the Section.

A further impetus was given to this movement when the American Laryngological, Rhinological and Otological Society at its annual meeting in Washington, in April, 1910, presented a "Symposium on the Deaf Child," participated in by expert teachers of the deaf and by otologists who have given this subject special study. A committee was appointed, consisting of Drs. E. B. Dench of New York City, G. Hudson Makuen of Philadelphia, and H. S. Birkett of Montreal, whose duty it shall be to endeavor to secure in every medical school in the United States and Canada the delivery during the course of at least one lecture on the educational problem presented by the deaf child.

Still another step was taken a few days later when the American Otological Society at its annual meeting in Washington, in May, 1910, appointed a committee for the same purpose, the membership of which is identical with that of the committee of the American Laryngological, Rhinological and Otological Society. It is hoped that these three committees, representing three important organizations of physicians who specialize on the ear and related parts, working as they will in entire harmony, may succeed in bringing before the profession the facts that will enable its members to render the utmost possible service to their deaf patients; a service which every practitioner is very ready to perform if he has the requisite information.

At the meeting of the Otological Section of the American Medical Association, in St. Louis, in June, 1910, the committee previously appointed made a report offering the following resolutions, which were adopted and the committee continued.

"Your committee in conference with Dr. Keir Love of Glasgow, Dr. Alexander Graham Bell of Washington and Prof. John D. Wright of New York City, have drafted the following resolutions as being the next step in carrying out the intention of the Section in its original motion:

Resolved, That the Otological Section of the American Medical Association adopt the following recommendations, and that the Chair be authorized to continue the existing committee, add to it, or appoint a new committee, as may seem best whose duty it shall be to endeavor to carry out the recommendations and to report at the next annual meeting of the Section.

1. That a medical inspection of all public school children be provided by the public school authorities which shall especially include expert examination of throat and ears. That the test applied to hearing shall

be whispered speech at eight feet, the back of the pupil being turned to the examiner.

2. That all cases of defective hearing should be classified under three groups: a. Those congenitally totally deaf; including those deaf in early infancy before speech and language have been acquired; b. Those adventitiously, totally deaf after speech and language have been acquired; c. Those partially deaf, or the so-called "hard of hearing."

3. That special instruction be provided suited to the particular needs of each of the three classes.

4. That the Otological Section of the American Medical Association issue a leaflet containing essential knowledge concerning the means available for meeting the educational needs of deaf children, and that this leaflet be distributed to the members of the Association with the request that they place it in the hands of parents of deaf children and in the hands of the superintendent of schools of their respective localities for distribution to the public school teachers.

5. That in all the medical schools of the United States, more instruction be provided during the course on the means available for ameliorating the condition of deaf children by education.

6. That there be appointed in connection with each public school system a visiting teacher, whose duty it shall be to visit the mothers of very young deaf children in their homes and instruct them in the means for meeting their educational needs."

Special stress should be placed upon the proper classification of cases as the requirements of each class are different. When the physician has determined to which of the three general classes the specific case belongs, he should then be able to suggest what particular instruction is needed and where it can be obtained. In the next publication of this special department in *THE LARYNGOSCOPE*, we will endeavor to make clear the special needs of each of the three classes and supply a list of the schools throughout the country where those needs can be supplied.

J. D. W.

SOCIETY PROCEEDINGS.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Regular Meeting, February 15, 1910.

Proceedings continued from page 925.

DR. GEORGE E. SHAMBAUGH, CHAIRMAN.

DISCUSSION.

DR. GEO. E. SHAMBAUGH takes exception to Dr. Fletcher's so-called "theory of synchronism" that the semi-circular canals never act separately but always in pairs, and that the direction of the nystagmus resulting from over-stimulation is always determined by that canal of the pair in which the flow of the endolymph is such as to produce the greatest physiological response. The fundamental facts in the physiology of the semi-circular canals underlying this question are: First, that the flow of the endolymph always results in a greater stimulation when moving in one direction in a canal than when moving in the other; second, that the direction of greatest response is not the same in all the canals. In the horizontal canals the greatest response is elicited when the endolymph moves from the ampulla towards the small end, whereas in both the superior and posterior canals the greatest response is obtained when the endolymph flows from the small end towards the ampulla; third, that the ocular manifestation resulting from the motion of endolymph in any canal is a slow movement of the eyes in the plane of the canal and in the same direction as the motion of the endolymph, and a quick movement of the eyes in the opposite direction.

Why it is that the greatest stimulation of the horizontal canal results when the endolymph flows from the ampulla towards the small end, and of the superior and posterior canals when the flow is from the small end towards the ampulla, we do not know. Dr. Fletcher has suggested two explanations. In one place he states that the force of gravity is the determining factor, because in the superior canal the flow of the endolymph from above downward to the ampulla results in this canal in a greater stimulation than when the endolymph moves from the ampulla upwards. As a

matter of fact, it is not clear that gravity can play any part in the motion of endolymph in closed canals filled with this fluid. In another place he states that the flow of endolymph into the wide-open ampullar end results in a greater stimulation than a flow in the opposite direction. This explanation could apply only to the horizontal canals, for in both the posterior and superior canals the greater response is produced when the endolymph flows from the smaller end towards the ampulla.

If one keeps in mind the fact that the direction of nystagmus is determined by the direction of the flow of endolymph in this or that canal irrespective of whether the particular canal is stimulated in the direction of its greatest physiological activity or not, a theory of synchronism, as Dr. Fletcher proposes, is in no way necessary to explain the phenomena of nystagmus. Suppose a person in the upright position is turned to the right causing a flow of endolymph in the horizontal canals, the direction of the nystagmus during turning will be towards the right, because in both of the horizontal canals the direction of the flow of endolymph will be such as to cause nystagmus to the right. For example, in the right horizontal canal, when turned to the right, there will be a flow of the endolymph from the small end of the canal towards the ampulla, the direction of least physiological activity. Such a response will produce nystagmus to the right. At the same time, in turning to the right, the flow of endolymph in the left horizontal canal will be from the ampulla towards the small end, the direction of greatest physiological activity for this canal. This direction of the flow of endolymph in the left horizontal canal will also produce nystagmus to the right. To assume that it is the left canal alone that determines the direction of the nystagmus, simply because it happens to be this canal that is stimulated in the direction of its greatest physiological activity is unnecessary. The direction of the nystagmus in turning is determined by both of the canals pulling in the same direction. The error in his argument is made still more apparent in cases where the left labyrinth is destroyed. Here the nystagmus on turning the patient to the right is still directed to the right, determined, of course, by the stimulation of the right horizontal canal, although this canal is now stimulated in the direction of its least physiological activity. An equally serious error is where he attempts to apply this theory of synchronism in explaining the nystagmus resulting from the stimulation of the labyrinth with hot or cold water. He asserts, for example, that in syringing the

right ear with warm water the nystagmus is toward the right, not however, because of the flow of the endolymph in the right superior canal, since in this canal the flow would be from the ampulla towards the small end, that is in the direction of least physiological activity for this canal. He asserts that the direction of the nystagmus to the right, in this case is determined from the opposite (left) ear, where he assumes that a flow of the endolymph also takes place, but in such a direction as to result in producing the greatest physiological response, that is, from the small end to the ampulla. Here, in order to make results conform with his theory, that the direction of the nystagmus is determined by a canal which is stimulated in the direction of its greatest physiological activity, Dr. Fletcher is forced to assume that when hot water is syringed into the right ear, stimulating the superior canal on this side in the direction of its least physiological activity, it produces at the same time in some mysterious way a motion in the endolymph in the left superior canal in an opposite direction, so that this canal will be stimulated in the direction of its greatest activity, thus allowing it to determine the direction of the nystagmus. The impossibility of such a claim is apparent without the demonstration that when the left labyrinth is destroyed and the right ear syringed with hot water the direction of the nystagmus is still to the right, although here this direction must be determined by the right canal alone, which is being stimulated in the direction of its least physiological activity.

In his discussion of the pairing of the canals of opposite labyrinths, the inference is that the superior on one side is paired with the superior of the other. As a matter of fact, it is only the two horizontal canals that seem to be paired in this way, since anatomically the superior canal on the one side lies in a plane parallel with the posterior canal of the opposite side.

DR. NORVAL H. PIERCE: The question regarding the current of the endolymph being the agency by which the crista is stimulated, is a very ancient one. There can be no flow of endolymph in such a non-compressible fluid without some space to take up the flow. It is a physical impossibility for flow to occur. That the semi-circular canal may react without such a flow being possible is proven in cases where both crura of a semi-circular canal are entirely cut through during operations. All the phenomena of static disturbance occur immediately after such an accident. If infection does not intervene, the semi-circular canal heals with its calibre

obliterated at the two points of severance. And yet in a number of these cases in which the semi-circular canals have been cut, normal functions have been re-established in them. Physicists hold that this stimulation was determined by molecular movements and not by mass movements of the endolymph. After reading over von Stein's book on the internal ear, one would believe it impossible to advance anything of a hypothetical nature that would be new in explaining the actions of the semi-circular canals. However, the matter is not closed. The majority of physiologists to-day believe that there is interreaction between all the semi-circular canals all the time, and if we go over the relationships which exist between the various movements of the crista, we will see that they are wonderfully planned in order that vertigo shall not occur in any of the movements of ordinary life. If for instance, the highest physiological activity was possessed by the hairs of the superior semi-circular canals, when they are directed toward the utricle, we would be dizzy whenever we shake the head. The highest physiological activity occurs when the hair-cells of the superior canals are directed upwards and downward in the horizontal canals. This interrelation must of necessity be so because otherwise we should be dizzy most of the time. Without accepting the hypothesis that space is absolute, I advocate the belief that the crista react to rotation, or angular acceleration just as the retina reacts to light. Not only are they physiologically active when the body is turned in any particular direction, but they are always in a state of tonicity. This explains why, if cold water is syringed into the right ear, we get nystagmus toward the left, because the hairs in the right static apparatus are directed toward the direction of at least psychological activity, and the hairs on the other side are in a relatively higher state of activity. We thus see that not only the semi-circular canals on the same side react one on the other, but that those on one side are co-related to those on the opposite side. This functional co-relationship is accomplished by means of the centers in the cerebellum and pus. This is the modern view of the physiology of the semi-circular canal system and is of the greatest value in our clinical work.

DR. A. H. ANDREWS: I would like to take exception to one statement which Dr. Fletcher makes, and that is, that in the caloric experiments it is the motion of the endo-lymph in the horizontal combined with the motion in the superior canals which produces rotary nystagmus. It is true that if you take the zygomatic

arch for a base line, the superior part of the horizontal canal dips a little, if you take Reid's base line, it will dip little, if any. As the patient holds his head, whether tilted forward to bring the canal horizontally, or whether the head is tilted backward, to make it dip at the back, you get rotary nystagmus just the same. I believe that the man who knows the most about this subject has a good deal yet to learn, and that the rest of us know comparatively little about it. We have a long way to travel before we will thoroughly understand the subject under discussion, but the progress which is being made is in the right direction.

DR. FLETCHER (closing the discussion): As to the misunderstanding which exists between Dr. Ballenger and myself, it is easily explained. Dr. Ballenger speaks of the side of the particular crista stimulated, while I speak of the side of the head and not the particular side of the crista.

I do not agree with Dr. Shambaugh that Ewald's experiments are conclusive. He showed, however, that it is the motion of the endolymph that regulates the occurrence of nystagmus. Høgyes, by introducing a hypodermic syringe into the cavity produced endolymph movement and displacement of the cupula.

As far as gravity is concerned, motion is exceedingly slight. It is not a flow of endolymph. It is a slight motion of endolymph, and occurs only momentarily. I believe the greatest part of the endolymph is in the utricle, and in turning the impact travels at some velocity and the flow of endolymph is in the opposite direction. The level of the indifferent ends is not on the same plane. Often it is lower than the level of the ampulla. If one side is destroyed, it is not a question of physiology, but one of pathology. The nerve centers adjust themselves to this condition. There are two directions of physiologic activity, and these act in both directions, and while both exist they both act physiologically, but do not act equally strong. When we syringe the right ear with cold water, we get vestibular action in the right ear. When we syringe with hot water we get action in the direction of least physiological activity.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON LARYNGOLOGY AND RHINOLOGY.

Regular Meeting, February 23, 1910

DR. JOSEPH H. ABRAHAM, CHAIRMAN

PRESENTATION OF PATIENTS.

A Case of Subglottic Stenosis Previously Demonstrated; Specimen Slide. Report. Instrument Used. By J. W. GLEITSMANN, M. D.

This case was presented at the Section four or five months previously. At that time nothing had been done to the patient. She suffered from extreme dyspnea, so that it was necessary to give her a card to the German Hospital for admission at any time, but unless this was demanded it seemed better to treat her at the office. When the case was first presented, the nose was in a bad condition,—there was poor circulation, polypoid excrescences on the middle turbinate, and stenosis. Dr. Emil Mayer had examined the patient at his own office. Many of the members at that time were inclined to consider it a case of scleroma, especially as the patient came from a region where scleroma is frequent. Dr. Gleitsmann himself reserved his opinion until after making further study and examination. He removed a section for examination on November 20, which was examined by Prof. McCullom, who made a diagnosis of submucous fibroma. The doctor made another excision opposite below the anterior commissure. The specimen thus obtained was small, and was shown by the doctor. This was sent to Dr. Higgins, who made a very careful examination. He reported a piece of tissue about the size of a split pea, covered with epithelium. Microscopic examination showed the tissue to be fibrous in structure; normal in appearance, with no tendency to prolongation. The underlying tissue is fibrous. Beneath the mucous membrane there is a narrow line of quite dense formation. So from two independent microscopic examinations we have the same diagnosis, viz., submucous fibroma. The patient has gained in weight, does her housework, and does not suffer from want of breath.

The condition of the larynx can be plainly seen. It is simply that of infiltration below the glottis. Her voice is not clear, but

that is due to some remaining tissue underneath. There is no need to dwell on the difficulty of taking out the tissue below the cord.

The two different examinations by different pathologists both resulting in the same diagnosis, seem to leave no doubt that the condition was a fibroma. The patient is leaving New York, but when she returns, Dr. Gleitsman will probably see her and may make another report of her condition.

Presentation of Instruments. By J. W. GLEITSMANN, M. D.

DR. GLEITSMANN said that at the previous meeting there had been some discussion about the difficulty in removing adhesions of the palate so that they would not return. He could not then recall the name of this instrument, nor of the man who devised it, but both had been obtained, and he now submitted it for inspection. The instrument is rather old.

In 1894, Harrison Griffin published an account of 22 cases of syphilitic lesions occurring from a month to fourteen years after the initial lesion. The method of operation is simple, and the dilator can be used by the patient himself. It is advisable that dilations be made in the first week 2 or 3 times, and later once or twice, by touching the edge where the pillar is severed with a solution of monochlor or diacetic acid the adhesions will be prevented from reforming. Dr. Griffin spoke very favorably of the instrument, and reported a number of cases which he had treated successfully with it.

Several Cases of Stoerk's Blennorrhoea. By WOLFF FREUDENTHAL, M. D.

DR. FREUDENTHAL was prevented from being present, but one of the patients was on hand, and was examined with interest.

Acute Phlegmonous Epiglottitis. M. D. LEDERMAN, M. D.

In reply to an inquiry from Dr. Gleitsmann as to whether he considered it a case of angina ludovici, Dr. Lederman replied that he considered it under the head of acute septic inflammation of the throat. Sir Felix Semon considers all these cases, no matter what they may be called, as one and the same disease, and that seems to be practically the fact. In reply to an inquiry as to whether the condition was confined to the epiglottis, Dr. Lederman replied in the negative. It had spread to the larynx.

DR. DELAVAN said that the case was interesting and had been admirably presented. Such cases are unusual, but it is probable that they occur more frequently than we are aware of, for the

diagnosis is not always easy, and in the hands of a man not well informed on diseases of the throat the patients may easily die without a diagnosis having been made. We not uncommonly hear of death occurring in cases of so-called acute tonsillitis, and possibly some of these cases are of the nature of the one just described. Sir Felix Semon assumes the broad position that all these different phlegmonous manifestations in the throat are one and the same thing. This might be true of them, histologically speaking, but clinically there is much difference between an angina Ludovici, for example, and such a case as Dr. Lederman had just reported, where the location of the pus was not in the floor of the mouth nor in the peritonsillar region. While Semon is scientifically correct, we should know more accurately where to search for the focus of infection. Classing them under the same head and as being one and the same thing would make it easy for an observer to wander from the important point, which, after all, was the precise location of the abscess. The cause is probably the same as that of erysipelas of the throat and larynx. In many respects they are very similar. An important point in all these cases is the necessity for early examination of the secretions of the mouth, especially of the affected part, in order to discover what organism is present. Presumably the streptococcus would be found responsible.

DR. GLEITSMANN agreed with Dr. Delavan that clinically the cases are different. There are many cases known where the patient was practically well one day and the next day was dead; and in other cases with the same pathological entity they take a favorable course. We have never been able to detect the toxic agent, though we know that a number are present. If we don't know for certain which of these micro-organisms brought on the infection, the injection is useless. It has been suggested that we procure a serum that will be a serum from all the different bacteria, but that has not yet been discovered.

DR. ABRAHAM said that he had treated about 10 cases of edema and one of phlegmon, and while he could not claim that ichthyol was the only thing that cured the patient, yet he had several times used a 25 per cent aqueous ichthyol solution in these cases with very satisfactory results. The solution was sprayed in the larynx every hour.

